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Volume LIX July-September 1996

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AN INVENTORY OF THE PHYLUM USTOMYCOTA

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ABSTRACT

A key and taxonomic synopsis are given for the ten orders recognized in the Ustomycota: those producing ustospores (Graphiolales, Septobasidiales, Sporidiales, Tilletiales, and Ustilaginales); those producing ustidiomes (Agaricostilbales, Atractiellales, Heterogastridiales, Platygloeales), and the Exobasidiales that forms neither. A glossary of specifically ustomycete terms is provided. The following nomenclatural matters are also treated: the order Tilletiatiales is divided between the Tilletiaceae and the Doassansiaceae (stat. nov.); the order Ustilaginales is divided between the Ustilaginaceae (emended) for species on monocots and the Microbotryaceae (fam. nov.) for species on dicots; two new families are described in the Atractiellales—Atractiellaceae and Camptobasidiaceae; and *M. violaceum* (Pers. : Pers.) Deml & Oberw., the type of *Microbotryum*, is provided a comprehensive nomenclatural analysis and synonomy.

INTRODUCTION

Since recognition of the phylum Ustomycota nearly 25 years ago (Moore, 1972) there has been a marked increase in the number of included taxa. During this period of time the dichotomy between the heterogeneous Ustomycota and the natural assemblage Basidiomycota (Moore, 1994), the other phylum in the subkingdom Basidiomycetia (Moore, 1994), has also become critically defined.

The ustomycetes have a number of characters that set them in contrast to the basidiomycetes proper (Moore 1987, 1996a). These species: **A.** are ordinarily dimorphic (Oberwinkler & Bauer, 1989; Gams, 1992; Boekhout et al., 1993; Ruiz-Herrera et al., 1993); **B.** have diverse 5S rRNA but which does not occur in Walker's Group 5 (Moore, 1988a); **C.** have layered septa with nanopores (Moore, 1996a; Bauer et al., 1995) that can be sharp-edged, e.g., *Leucosporidium* (Moore, 1972) or slightly lipped (SLN; Moore, 1996a), e.g., *Ustilago* (O'Donnell & McLaughlin, 1984) and the bunt *Oberwinkleria* (Vánky & Bauer, 1995) and which lack paraseptal cytoplasmic differentiation and distinctive occlusions—i.e., there is no congruence with the dolipore/parenthesome system of the Basidiomycota (Moore, 1985; Oberwinkler & Bauer, 1989). Nor should these septa be confounded with those of the Uredinales whose paraseptal cytoplasm is delimited by a shell of vesicles or with those of the ascomycetes which are homogeneous, have large pores with rounded rims, and are accompanied by a pair, occasionally more, of Woronin bodies (Markham & Collinge, 1987; Turnau et al., 1993; Markham, 1994). **D.** may have clamps (fibulae); if present they may be regular, as in the basidiomycetes proper (e.g., Oberwinkler & Bandoni, 1982c), or meristematic, forming additional hyphae (Seyfert, 1927) or spores. **E.** may have lenticular bodies, bull's eye structures with dark cores and thick, electron translucent walls associated with the cell walls, which are apparently a unique and diagnostic feature of the cells of these fungi. They have been reported in *Bensingtonia*, *Farysia*, *Leucosporidium*, *Rhodosporidium*, *Sporidiobolus*, and *Sporobolomyces* (Kreger-van Rij & Veenhuis, 1971a, 1971b; Johnson- Reid & Moore, 1972; Moore, 1972; de Hoog & Boekhout, 1982; Boekhout et al., 1992). Similar lenticular bodies, colacosomes, have been reported for *Platygloea peniophorae* (Bauer & Oberwinkler, 1991).

The marked differences between the two basidiomycete phyla has engendered sets of analogous terms for the two taxa (Moore, 1996a): basidium/ustidium, basidiospore/sporidium, teliospore/ustospore, and basidiome/ustidiome (basidiocarp/ustocarp). Brief notes on the ustomycete structures follow. Depending on the species, **ustidia** may be entire (**holoustidium**) or septate (**phragmoustidium**). Holoustidia produce terminal sporidia (e.g., *Tilletia*), generally of a fixed number, and may subsequently become variously septate. Phragmoustidia develop four or more parallel septa after meiosis and each cell produces an indeterminate number of lateral sporidia (e.g., *Ustilago*). The **metaustidium** is the morphological part or developmental stage in which meiosis occurs. **Sporidia**, produced as a direct consequence of meiosis, are usually produced from ustidia in indeterminate numbers; they are nearly always passively released, and grow by budding (Jacobs et al., 1995) in the manner of basidiomycetous yeasts (e.g., *Mrakia* (Srivastava & Smith, 1974); *Erythrobasidium* (Suh et al., 1993); *Filobasidium* (Moore & Kreger-van Rij (1972); Fig. 1); they may be formed in a bud-like manner on a broad base, leaving a basidiomycetous collar (Fig. 1), or on a pedicel.

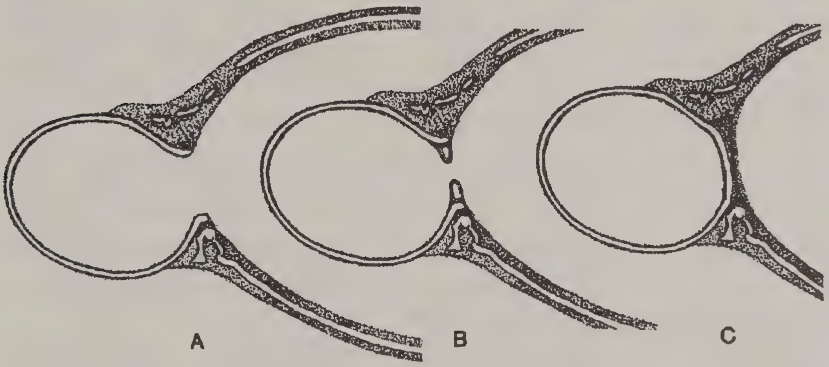


Fig. 1. Percurrent budding sequence in basidiomycetous yeasts (note that the bud has the same dark:light:dark profile as the parent cell): A. The emerging primary bud ruptures the mother cell wall, particularly the electron translucent layer; B. Septagenesis, during which time electron dense and light materials are deposited in the lumen of the invaginated membranes; C. the light component of the bud scar becomes part of the bud wall (from Moore, 1989). After bud separation an indeterminant number of subsesquent buds emerge through the same locus, resulting in a ruff of splayed wall layers around the bud site. This type of budding is characteristic of yeasts phases of the Ustomycota and the Tremellales (Basidiomycota).

Ustospores are sexual spores formed from dikaryotic hyphae; initially binucleate, they become diploid by maturity. During germination the diploid nucleus may divide mitotically before it or a daughter nucleus moves into one or more metaustidia and undergoes meiosis; the diploid nucleus remaining in the spore may repeat the cycle (e.g., Nagler et al., 1990). The surface of ustospores with sculptured, multilayered walls is composed of electron dense ornamentations that are projections of an inner wall extending to or through electron translucent material of the outer wall; continuous wall layers, underlying these thick, fissured jacketing layers, could be imagined as being like the walls of ustospores that are relatively thin-walled and smooth.

When the phylum Ustomycota was described, the assignment of *Rhodosporidium*, *Leucosporidium*, and *Filobasidium* was unresolved (Moore, 1972). Subsequently, the demonstration of the unique dolipore/parenthesome septal structure of the tremellaceous fungi lead to the establishment of the suborder Tremellineae (Moore, 1978) and the Filobasidiales in the superorder Tremellanae (Jülich, 1981). Later, Moore (1980) proposed two classes based on nutrition—Ustomycetes for the very large assembly of bunts and smuts and Sporidiomycetes for, at that time, the few saprobic species. In the intervening years, however, there has been a marked increase in the number of saprobic species. The interplay of morphology and septal ultrastructure and the data of molecular biology show the complex to be heterogeneous and probably polyphyletic. These developments make the endorsement of classes no longer tenable. The phylum presently comprises ten orders whose life cycles (Fig. 2) are, with few exceptions, dimorphic (Moore, 1980; 1996a). Three of the orders are modern segregates from the traditional Auriculariales (Atractiellales, Heterogastridiales, and Platygloeales). These orders and certain other taxa can be distinguished as follows:

SYNOPTIC OUTLINE OF THE USTOMYCOTA

1.1 Ustospores absent (Fig. 2a) 2
1.2 Ustospores present (Fig. 2b) or, if absent,
septa of the *Septobasidium*-type 4

2.1 Ustidiomes absent, forming leaf galls; holo-
ustidia forming a superficial layer; sporidia,
usually 4, borne abaxially on terminal
pedicels . . . . EXOBASIDIALES

2.2 Ustidiomes present, producinging holo- or phragmoustidia 3

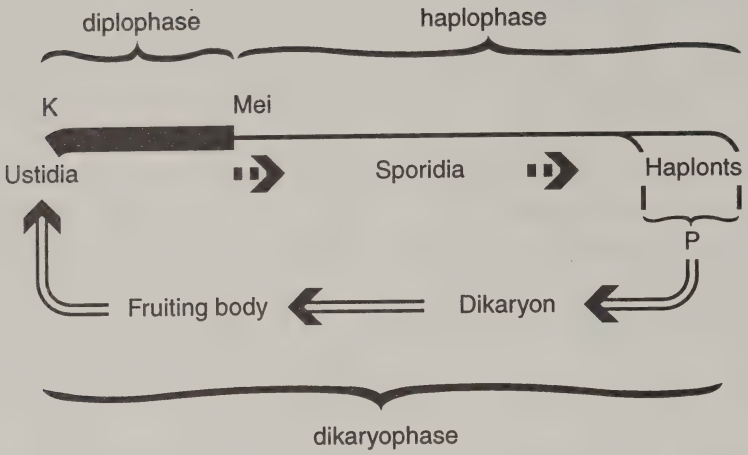
3.1 Ustidiomes typically effused and gelatinous; ustidia phragmous; sporidia variously globose PLATYGLOEALES
3.2 Ustidiomes coremioid, bearing terminal heads of phragmo- or holoustidia, hyphae efibulate; sporidia variously globose . . . . ATRACTIELLALES
3.3 Ustidiomes stipitate, stilboid, capitate . . . AGARICOSTILBALES
3.4 Ustidiomes pulvinate, hyphae fibulate; sporidia variously globose; septa of the *Septobasidium*-type . . . . *Atractogloea* (SEPTOBASIDIALES)
3.5 Ustidiomes lageniform; sporidia digitate HETEROGASTRIDIALES

4.1 Ustospores thick-walled and variously rugose; phytopathogenic or saprobic 5
4.2 Ustospores thin-walled and smooth 6

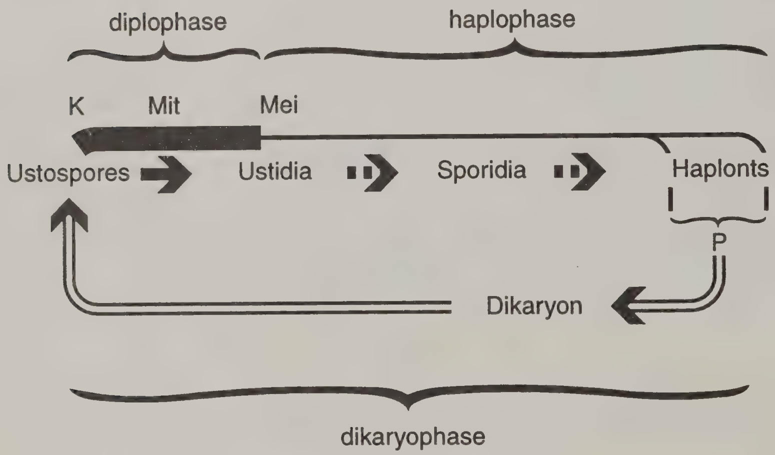
5.1 Parasitic, germination producing holoustidia that form terminal, falcate sporidia . . . . TILLETIALES
5.2 Parasitic, germination producing phragmoustidia that form lateral, globose sporidia near the septa . . . . USTILAGINALES
5.3 Saprobic, germination producing phragmoustidia that produce lateral, subfusiform, curved sporidia on pedicels. . . . . . *Tilletiaria* (USTILAGINALES)

6.1 Free-living. . . . . SPORIDIALES
6.2 Forming parabiotic associations 7

7.1 Septa with three zones of different thicknesses, *Septobasidium*-type; symbiotic/parasitic with scale insects . . . . Septobasidiaceae (SEPTOBASIDIALES)
7.2 Septa with three zones of different thicknesses, *Septobasidium*-like . . . . . Atractogloeaceae (SEPTOBASIDIALES)
7.3 Septa with sharp edged nanoscopic pores, sometimes with pulley-like inclusions; parasitic on palms. . . . . GRAPHIOLALES


diplophase
haplophase
K
Mei
Ustidia
Sporidia
Haplonts
P
Fruiting body
Dikaryon
dikaryophase

a. Life cycle of carpophoric ustomycetes


diplophase
haplophase
K
Mit
Mei
Ustospores
Ustidia
Sporidia
Haplonts
P
Dikaryon
dikaryophase

b. Life cycle of ustosporic ustomycetes

Fig. 2. Generalized life in the Ustomycota (from Moore, 1996a). See text for details. Key: K = karyogamy; Mei = meiosis; Mit = mitosis; P = plasmogamy.

PROFILES OF THE ORDERS

1. ORDER AGARICOSTILBALES Oberwinkler & Bauer. The ustidiomes comprise capitate synnemata bearing heads of phragmoustidia. The septa of *Agaricostilbum palmicolum* Wright emend. Oberw. & Bauer and *A. hyphaenes* (Har. & Pat.) Oberw. & Bandoni (1982b), the only species in the single family (Oberwinkler & Bauer, 1989), have simple pores with sharp-edged rims similar to the pores found in *Rhodosporidium toruloides* Banno (Johnson-Reid & Moore, 1972) and *Leucosporidium scottii* Fell, Statzell, Hunter & Phaff (Moore, 1972). The sporidia bud in the manner of basidiomycetous yeasts (Oberwinkler & Bauer, 1989).

2. ORDER ATRACTIELLALES Oberwinkler & Bandoni. The order comprises five families—Atractiellaceae and Camptobasidiaceae, both described below, Chionosphaeraceae, Pachnocybaceae, and Phleogenaceae—and brings together those saprobic genera that have coremioid ustidiomes bearing terminal heads of phragmo- or holoustidia.

The septa of *Atractiella*, *Chionosphaera*, *Phleogena* (Oberwinkler & Bandoni, 1982b; Oberwinkler & Bauer, 1989) *Pachnocybe* (Kleven & McLaughlin, 1989), and *Stilbum* (Oberwinkler & Bauer, 1989) are similar to those found in *Rhodosporidium toruloides* (Johnson-Reid & Moore, 1972) and *Leucosporidium scottii* (Moore, 1972). The pores have sharp-edged rims, are sometimes associated with dark material that may be granular and, from the micrographs, are 35-150 nm diam. The ustidia are divided or undivided and bud sporidia freely on broad bases. The sporidium shown for *Agaricostilbum* has characteristic basidiomycete-type budding (Oberwinkler & Bandoni, 1982b).

When Oberwinkler & Bandoni (1982b) established the order they designated *Atractiella* the type genus. Elsewhere in their article *Agaricostilbum* and *Atractiella* were assigned to the family Hoehnelomycetaceae. The Hoehnelomycetaceae (Oberwinkler & Bauer, 1989), however, is typified by *Hoehnelomyces javanicus* Weese, a later synonym of *Atractiella macrospora* (Penz. & Sacc.) R.T.Moore (1987) {type species *Sphaeronemella* *macrospora* Penz. & Sacc.}. The following action is therefore required:

Atractiellaceae R.T.Moore **fam. nov.**
Ordo Atractiellales. Ustidiomata hyphae hyalinus, efibulatus; sporidia hyalinus. Typus *Atractiella* Sacc.

Order Atractiellales. Ustidiome hyphae, hyaline, lacking clamps; sporidia hyaline. Type *Atractiella* Sacc.

Camptobasidium hydrophilum Marvanová & Suberkropp (1990) is a freshwater aquatic species characterized by fibulate hyphae, septa with nanoscopic pores, curved phragmoustidia that produce drop-shaped to clavate sporidia. Its anamorph, *Crucella subtilis* Marvanová & Suberkropp (1990), produces tetra-radiate conidia. The authors believed this fungus should be classified in its own family in the Atractiellales but reserved judgement because the teleomorph was known only from cultured material. There are, however, a number of species and strains whose teleomorphs are only known from culture (e.g., *Rhodosporidium toruloides* and *Filobasidiella neoformans*). Though unobserved in nature, eliciting the sexual stage in the laboratory can facilitate classifying the holomorph. I accept the view that this species belongs in a separate family and therefore provide the following diagnosis:

Camptobasidiaceae R.T.Moore **fam. nov.**
Phylum Ustomycota, Ordo Atractiellales. Natura eadem *Camptobasidium* Marvanová et Suberkropp (1990), genus typicum: "… basidia sparsa, singulatim ad hyphas, apicalia, curvata, matura typice quadricellularia; basidiosporae laterales apicalesque, aggregatae, sessiles, tarde liberantes, guttuliformes usque ad clavatae."

3. ORDER EXOBASIDIALES Lindau. This monotypic order of leaf parasites lacks ustidiomata; the holoustidia produce sporidia on pedicels. The order is dominated by the fifty or so species of *Exobasidium*. The septa of the efibulate hyphae of *E. camelliae* Shirai, *E. rhododendri* (Fkl.) Cramer, and *E. vaccinii* (Fkl.) Woronin, are simple with small pores with rounded rims that sometimes have electron dense plugging (Blanz, 1978; Khan et al., 1981; Patrignani et al., 1989).

The ultrastructure of holoustidia and sporidia of *E. camelliae* var. *gracilis* Shirai, *E. japonicum* Shirai, *E. myrtilli* Siegm., *E. oxycocci* Rostr., *E. rhododendri*, *E. vaccinii*, and *E. warmingii* Rostr. have been reported by Blanz (1978) and Mims et al. (1987). The ustidial initials develop within the dikaryotic stroma and give rise to lateral, uninucleate metaustidia on the abaxial leaf surface. After meiosis four to seven pedicels develop per holoustidium whose tips enlarge into sporidia that, in turn, become elongated and curved like basidiospores but, unlike basidiospores, are attached abaxially, rather than adaxially (see Corner, 1948), and develop no hilar appendix body or discharge droplet. Separated sporidia grow in a yeastlike manner (Mims & Richardson, 1987); the yeast-phase is unnamed. See also Oberwinkler (1982); Blanz & Oberwinkler (1983).

Microstroma juglandis (Berenger) Sacc. has basidiomycetous type budding (Blanz, 1978; von Arx et al., 1982) and simple, ustomycetous septa with pores with rounded rims (Blanz, 1978). See also Moore (1982; 1985).

Coniodictyum chevalieri Hariot & Pat. and *Dicellomyces* sp. are also reported to have simple septa (Oberwinkler & Bandoni, 1982b). See also Parmasto (1968), Ingold (1985), Nagasawa (1987).

Other genera ascribed or ascribable to the order (and recent citations) include *Articularia* (Cox, 1976; Moore, 1985), *Brachybasidium*, *Botryoconis* (*Cryptobasidium*), *Ceraceosorus* (Cunningham et al., 1976), *Exobasidiellum* (Bandoni & Johri, 1975), *Helostroma* (Moore, 1982), *Korydana* (Barreto & Evans, 1988; Gruezo, 1990), *Muribasidiospora* (Patil, 1977), and *Proliferobasidium* (Cunningham et al., 1976). See also Donk (1956).

4. ORDER GRAPHIOLALES Donk ex Bandoni & Oberwinkler. The ultrastructure and life history of *Graphiola phoenicis* (Moug.) Poiteau, the only species and a parasite of palms, has been critically examined by Cole (1983) and Oberwinkler et al. (1983b). Yeast-phase cells on a leaf become hyphal, allowing the fungus to enter the host via the stomata; ustidiomes then develop within the leaf and eventually rupture to the surface. Within this fruiting structure the fertile hyphae, which have septal pores that are about 75 nm in diameter, form a palisade of dikaryotic cells that generate chains of cells that mature basauxically. Karyogamy occurs part way up a series (ustospore initiation), followed by meiosis several cells later. Meiosis is followed by further nuclear divisions. Each ustospore then buds a number of ustidia. As a ustidium matures it becomes warty and thick-walled and divides to form a two-celled phragmoustidium whose final maturation results in sets of daughter cells which separate to become pairs of seceding spores that are smooth on their opposing faces. Germination of these spores, encysted ustidial cells, establishes the sporidial yeast phase.

Ustilago welwitschia Bresadola, occurring on *Welwitschia mirabilis* Hook. f., is doubtfully one of the Ustilaginales and seems to be near the genus *Graphiola* (Zundel, 1953).

It is also worth noting here Durán's (1987) description of *Mycosyrinx* Beck (Ustilaginales): "Spores usually in pairs, each member a complementing half of a sphere, partly separating along the smooth, contiguous surfaces but remaining attached at midpoint of the bulging centers, 15-17 X 11-14 µm, petitely but obscurely verruculose on the free outer surfaces, at maturity resembling open clamshells."

5. ORDER HETEROGASTRIDIALES Oberwinkler & Bauer. The flask-shaped ustidiomes produce phragmoustidia from a basal hymenium; the sporidia are digitate (Oberwinkler et al., 1990a). The simple septa of *Heterogastridium pycnidioideum* Oberwinkler & Bauer, the only species in the single family, are similar to those found in *Rhodosporidium toruloides* (Johnson-Reid & Moore, 1972) and *Leucosporidium scottii* (Moore, 1972). The pores have sharp-edged rims, a diameter of 60-80 nm at maturity, and are accompanied by dense granules. The anamorph is *Hyalopycnis blepharistoma* (Berk.) Seeler (Bandoni & Oberwinkler, 1981).

6. ORDER PLATYGLOEALES Moore. The ustidiomes of this monotypic order are gelatinous (to arid) and typically effused (Moore, 1990; 1994). As well as the long established genera the order also includes a number of recent, mostly monotypic, genera; type species are given for the latter.

In *Helicobasidium mompa* Pat. the branch hyphae are initiated in a budding manner and the septa have simple pores that are 100-

175 nm across and may have associated dense granules (Bourett & McLaughlin, 1986). The simple pores of *Colacogloea* (Oberwinkler et al., 1990b) {type species *Platygloea peniophorae* Bourd. & Galz.} are about 14 nm across, those of *Kriegeria eriophori* Bres. are typically 26 nm in diameter (Doublés & McLaughlin, 1991), those of *Platygloea disciformis* (Fr.) Neuhoff have diameters ranging between about 28 nm (Oberwinkler et al., 1990b) and 300 nm (Aoki et al., 1986), while those of *Pl. navispora* Aoki & Tubaki are about 80-95 nm across and are accompanied by dense granules (Aoki et al., 1986). Similar simple septa also occur in *Herpobasidium filicinum* Lind (Oberwinkler & Bandoni, 1984; Bauer & Oberwinkler, 1994) and *Naohidea* {type species *Dacrymyces sebaceus* Berk. & Br.} and *Occultifur* {type species *Platygloea peniophorae* var. *interna* Olive} (Oberwinkler, 1990). The septa of *Jola*, *Kriegera* (= *Xenogloea*; Kao, 1956), *Mycogloea*, *Neotyphula*, *Paraphelaria*, and *Platygloea* have also been reported to have simple pores (Oberwinkler and Bandoni, 1982a; Doublés & McLaughlin, 1991; Frieders & McLaughlin, 1993).

Colacosomes, bull's eye-like lenticular bodies, have been described in *Colacogloea peniophorae* (Bourd. & Galz.) Oberwinkler et al. (Bauer & Oberwinkler, 1991).

Concerning the anamorph genus *Rhizoctonia* (≡*Thanatophytum*). The teleomorph of the type species, *R. crocorum* (Pers. : Fr.) DC, is *Helicobasidium purpureum* Pat. Of the 119 specific or subspecific epithets described in the genus only seven are considered to be validly published (Andersen & Stalpers, 1994); all but *R. crocorum* are assigned to the basidiomycetes proper: *Ceratorhiza oryzae-sativae* (Sawada) R.T. Moore, *C. ramicola* (Weber & Roberts) R.T.Moore, *Epulorhiza anaticula* (Currah) Currah, *Moniliopsis anomala* Burgeff ex Currah, *M. solani* (Kühn) R.T.Moore, *M. zeae* (Voorhees) R.T.Moore. (see also Stalpers & Andersen, 1996.)

Four other genera that are probably in the order are *Kryptastrina* {type species *K. inclusa* Oberwinkler, 1990}, *Insolibasidium* {type species *Herpobasidium deformans* Gould} said to be close to *Herpobasdium* (Oberwinkler & Bandoni, 1984), *Phyllogloea* (Lowy, 1959; 1971) for two foliose species segregated from *Platygloea* (Bandoni, 1956), and *Zygogloea* {type species *Z. gemellipara* Roberts, 1994}. Other genera that may be here or, perhaps, in the Septobasidiales (see below) are

Platycarpa and *Ptechetelium* {type species *Herpobasidium cyatheae* Sydow} (Oberwinkler & Bandoni, 1984).

7. ORDER SEPTOBASIDIALES Couch ex Donk. The order comprises two families: the very large Septobasidiaceae, associated with scale insects, and the Atractogloeaceae. The efibulate hyphae of *Septobasidium* form a parabiotic association with scale insects (Couch, 1938). The ustospores may be indurate, thin-walled, or absent. The ustidia may be entire or up to three septate. The sporidia, borne on prominent projections, usually become one septate after secession and germinate by budding. Couch (1938) recognized nine distinctly different types of ustospores and ustidial structure, and used them as major headings in his key to species, but cautioned that they should not be used as the basis for establishing subgenera because the groups showed a remarkable overlapping in practically all other structural characters. The sections he cited and the number of species given in each are as follows:

•Ustidia 1-celled, with persisting ustospore	2
•Ustidia 2-celled, without persisting ustospore	17
•Ustidia 2-celled, with persisting ustospore	13
•Ustidia 3-celled, without persisting ustospore	1
•Ustidia 3-celled, with persisting ustospore	1
•Ustidia 4-celled, coiled, without persisting ustospore	15
•Ustidia 4-celled, straight, with persisting ustospore	49
•Ustidia 4-celled, coiled, with persisting ustospore	41
•Ustidia 4-celled, straight or slightly bent, without persisting ustospore	10
•Species in which ustidia had not been found	31

This is a large genus much in need of modern study. Dykstra (1974) showed the septal ultrastructure of *Septobasidium apiculatum* Couch, *S. burtii* Lloyd, *S. mariani* Bres., *S. pseudopedicellatum* Burt, and that of a hybrid between the last named species and *S. schweinitzii* Burt. In profile these septa have three zones: (1) a small central zone (about 51-63 nm thick) in which the three layers are nearly equal and at whose center is a small pore, 26-42 nm in diameter, with an associated pair of dense granules, (2) a shoulder zone that widens abruptly, (132-)314-480 nm thick, and then rounds into (3) a peripheral zone.

Other genera associated with scale insects that have been ascribed to the Septobasidiaceae but whose ultrastructure is unknown include *Coccidiodictyon*, *Ordonia*, and *Uredinella* (Oberwinkler, 1989).

Atractogloea stillata Oberwinkler & Bandoni (1982c), the type species of the Atractogloeaceae (Oberwinkler & Bauer, 1989), has similar septa: the shoulders are about 300-400 nm thick, the center about 50-75 nm thick, and the pores about 25-35 nm in diameter. Other genera that are listed *pro tem.* in the Platygloeales (see above) but whose septal morphology may cause them to be redesignated to this family include *Platycarpa* and *Ptechetelium* (Oberwinkler & Bandoni, 1984).

8. ORDER SPORIDIALES Moore. This order is by way of being the free-living analogue of the Ustilaginales and Tilletiales (see Boekhout et al., 1992). There are two families (Moore, 1980): Sporidiaceae (the name is derived from the abbreviated generic name *Rhodosporidium*) has species with passively dispersed sporidia and the Sporidiobolaceae has species with ballistosporidia. The well established genera (and their anamorphs) are *Cystofilobasidium* (*Rhodotorula*), *Leucosporidium* (*Vanrija*?), *Rhodosporidium* (*Rhodotorula*), *Sporidiobolus* (*Sporobolomyces*) (Boekhout, 1991), and *Sterigmatosporidium* (*Sterigmatomyces*?); the anamorph genus *Ballistosporomyces* appears to be close to *Sporobolomyces* (Boekhout et al., 1992) but, like similar genera, lacks a known teleomorph (Nakase et al., 1989). The many species in the order have been intensively studied and a variety of morphological, physiological, and molecular biological criteria have been used to determine the circumscription of genera (teleomorphic and anamorphic) (Boekhout, 1991). The nomenclature is still evolving but a working stability is provided by Kurtzman & Fell (1996). Boekhout (1991) makes the sensible suggestion against nomenclaturally separating telomorphic and anamorphic fungi at the level above genera when it concerns biological entitites which do not need to be taxonomically separated.

The ultrastructure of *Rhodosporidium toruloides* was studied by Johnson-Reid (Reid, 1970; Johnson-Reid & Moore, 1972). The pores have sharp rims, are about 14-23 nm across, and may have associated electron opaque granules. Hyphae, viewed by light microscopy, bear what look to be regular clamps as well as hookcells over septa and hookcells bearing sessile ustospores. Electron microscopy shows ustospores as arising from penultimate cells in a crozier-like, double clamp configuration. The electron micrographs give the general impression that the apparent clamp connections may really be early stages in spore formation because they have somewhat amorphous (transitory?) profiles in contrast to the precise, fixed morphology of those of the Basidiomycota and some ustomycetes (e.g., Oberwinkler & Bandoni, 1982c). The drawings of amorphous clamp/ustospore configurations in *Sporidiobolus roseus* Kluyver & van Neil are comparable (de Hoog & Boekhout, 1982). Moore (1996a) gives a diagramatic interpretation of ustospore development based on Seyfert's (1927) drawing for hookcell formation in *Ustilago vuijckii* Oudemans & Beijerinck except that the penultimate cell becomes a lateral or terminal spore rather than remaining hyphal. Micrographs of *Kondoa (R.) malvinellum* (Fell, 1970; Yamada et al., 1989) and *Leucosporidium scottii* (Moore, 1972) and drawings of *Sporidiobolus pararoseus* Fell & Tallman (de Hoog & Boek-hout, 1982) suggest a comparable ustospore ontogeny. Patterns of hyphal growth are similar to those in the Ustilaginales (see below).

Concerning *Bensingtonia.* Boekhout (1987) reported that *Bensingtonia* and *Sporobolomyces* shared, among other characters, the absence of xylose in the cell walls, the absence of episterol, and the presence of gamma-linolenic acid. Yamada & Nakagawa (1988) electrophoretically compared *B. ciliata* Ingold with a number of the Q-9 ubiquinone species of *Sporobolomyces* (Nakase, 1987). They found that while it had ubiquinone Q-9 that it formed a cluster on its own. They suggested that these species should be transferred to *Bensingtonia*, an action that was taken by Nakase & Boekhout (1988) who emended *Bensingtonia* to permit the inclusion Q-9 species of yeasts that formed pigmented colonies and curved ballistospores; an additional species from South Africa was described by van der Walt et al. (1989). Nine species are currently recognized in the genus (Boekhout, 1991).

The genus *Cystofilobasidium* {type species *Rhodosporidium capitatum* Fell, Hunter & Tallman}, its name not withstanding, belongs in this order (Moore, 1996a). It has ustomycete septa with pores that are ~18-50 nm in diameter and, like *Leucosporidium* and *Rhodosporidium*, siderochromes composed of rhodotorulic acid as do those species of the Ustilaginales that infect dicot hosts (Deml, 1987). The intercalary, serial cysts are reminiscent of the hyphal ustospores diagrammed by Seyfert (1927) for *Ustilago vuijckii*. The genus is best interpreted in the Sporidiaceae with ustospores producing holoustidia terminating in sporidia and subtending cells.

9. ORDER TILLETIALES Kreisel. The order comprises two families: Tilletiaceae, bunts that are particularly common on festucoid grasses (Watson, 1972) and **Doassansiaceae** (Azbukina & Karatygin) R.T.Moore, **stat. nov.** (Azbukina, 1990), species on paludal or aquatic plants (*Burrillia*, *Doassansia*, *Doassansiopsis*, *Pseudodoassansia*, *Nannfeldtiomyces*, *Narasimhania*, and *Tracya*.). The spores are smooth or thickened and variously ornamented with tubercules, warts, or areolae with shallow to ridge-like boundries but not spines (Weete et al., 1969; Zogg & Schwinn, 1971; Hess & Gardner, 1983; Mordue & Ainsworth, 1984; Durán, 1987; Trione et al., 1989); they are probably formed in the same manner as in the Ustilaginales. The walls of *Tilletia caries* (DC) Tulasne and those of *T. controversa* Kühn appear similar but the outer reticulated layer of the latter fluoresce yellow-orange while the former do not (Stockwell, 1986).

The bunts generally form holoustidia, at least initially, that may become branched (e.g., Durán, 1979). At least four nuclear divisions occur after germination. Exceptionally, meiosis in several species of *Tilletia* occur within the ustospores before the emergence of the ustidium (Goates & Hoffman, 1987) and the spores of *Neovossia indica* (Mitra) Mundkur (Therrien et al., 1988) are always multinucleate at the time of germination. The resultant eight or more nuclei migrate into the falcate terminal sporidia which may become multinucleate (Durán, 1979). The subtending portion of the ustidium usually becomes several septate after spore formation (Zundel, 1953). Sporidia may remain discrete, e.g., *T. aegopogonis* Durán (1972), but more commonly fuse in pairs *in situ*. In *T. caries* the conjugation pegs emerge like basidiomycetous buds (Moore, 1988b) then fuse to effect plasmogamy (Kollmorgen et al., 1979). See also Duran & Fischer (1961) and Ingold (1995).

Ciferri (1959) gave a nomenclatural analysis of three anamorph genera that he placed in his family Entylomellaceae (the respective teleomorphs are given in parentheses): *Entylomella* (*Entyloma*), *Paepalopsis* (*Urocystis*), and *Savulescuella* (*Doassansia* and *Tracya*). The anamorph genus *Tilletiopsis* (Boekhout, 1991) is affined to *Entyloma*, *Melanotaenium*, and *Tilletia*. See also Boekhout et al. (1992).

10. ORDER USTILAGINALES Clinton. The order comprises three families: Ustilaginaceae, smuts that are particularly common on panicoid and chloridoid grasses (Watson, 1972), Microbotryaceae, described below, for species occuring on dicots, and Tilletiariaceae that is non-parasitic. The thickened spore walls are variously ornamented with spines, tubercules, warts, or areolae with shallow to ridge-like boundries (Weete et al., 1969; Grand & Moore, 1970; Moore & Grand, 1970; Zogg & Schwinn, 1971; Ramberg & McLaughlin, 1980; Mordue & Ainsworth, 1984; Deml et al., 1981; Durán, 1987, 1991a,b). Popp's (1955) diagram of hyphal growth in *Ustilago nuda* (Jens.) Rostr. (reproduced in Fisher & Holton, 1957; Moore, 1972) is noteworthy because it shows a pattern of cell division in which a dikaryotic cell produces three cells that are 1:2:1–karyotic followed by the monokaryotic cells forming hyphal extensions that fuse to restablish a dikaryotic cell. One can envisage that many repetitions of this pattern would form a nest of dikarytoic and monokaryotic cells of which the former would eventually become ustospores and the latter, perhaps, sterile cells. Ustospore formation described for *U. striiformis* (Westend.) Niessl (Mims et al. 1992) fits this kind of ontogeny.

At the end of meiosis the ustidium becomes 3- or 4-celled with the basal cell occupying the spore (Zundel, 1953; Ingold, 1989). Extra ustidia can be formed (Fischer & Holton, 1957; Christensen, 1963; Durán & Safeeulla, 1968; Ingold, 1983; Nagler et al., 1990). The primary haplo-nuclei continue to divide and further development is unspecific and various. Ustidia can form additional septa (Fischer & Holton, 1957; Durán & Safeeulla, 1968). These secondary septa, like the primary septa, are simple perforate with slightly enlarged pore margins, and about 20 nm across.

There is a major dichotomy between the smuts infecting monocots and those infecting dicots (Deml, 1987). These differences are taxonomically significant and make it desirable to partition these species into two families: Microbotryaceae and Ustilaginaceae.

Microbotryaceae R.T.Moore **fam. nov.**
Ordo Ustilaginales, fungi Dicotyledonum parasitici. Sporidia sessilia; siderochroma rhodotorulic-acidum; 5S rRNA qualis A; bacilysinum praesens.
Typus: *Microbotryum* Lév.

Order Ustilaginales, fungi parasitizing dicotyledons. Sporidia sessile; siderochrome of the rhodotorulic acid type; 5S rRNA of type A; bacilysin present.
Type: *Microbotryum* Lév.

Ustilaginaceae L. & C. Tulasne **emend.** R.T.Moore
Order Ustilaginales, fungi parasitizing monotyledons. Sporidia borne on pedicels; siderochrome of the ferrichrome type; 5S rRNA of type B; bacilysin absent.
Type: *Ustilago* (Pers.) Roussel.

The Microbotryaceae currently comprises two genera. *Bauhinus* {type species *Ustilago tragopogonis-pratensis* Pers.}, occuring on Polygonaceae, Dipsaceae, and Compositae (Moore, 1992), shows the basic pattern of a persistent four-celled ustidium in which the three septa are discernible beyond the spore (Ingold, 1985b; 1989). *Microbotryum* {basionym *Uredo violacea* Pers.} (Celerin et al., 1994), occurs on Caryophyllaceae; the three-celled ustidium is deciduous with the nucleate ustospore comprising the fourth cell (Ingold, 1989). A clarification of the typification of *Microbotryum* follows.

Deml & Oberwinkler (1982; 1983) revived *Microbotryum* Lév. to accommodate the anther smuts of Caryophyllaceae, a few species that they believed formed a natural group. They designated *Microbotryum antherarum* Lév. as the lectotype species and *Ustilago antherarum* Fries as its basionym.

Léveillé's (1847) original description of the genus is as follows:

> 7. *Microbotryum* +. Réceptacle composé de filaments rameux; ramifications renflées au sommet, et supportant 8-20 spores: spores sphériques.
> *Ustilago antherarum*, Lév. *U. receptaculorum*, Lév. *U. Montagnei*, Tul.

This citation has generated nearly a century and a half of nomenclatural confusion and misinterpretation. Although Léveillé (1847) provided a "... concordance des noms anciens avec ceux que j'établis: ... *Uredo antherarum* DC. = *Microbotryum* ...." at the end of his paper, he never transferred any of the species that he listed. In a later paper, Léveillé (1849) extended the list to include *Ustilago rudolphi* Tul. but, again, effected no new combinations. (It could well be asked (Art. 34.1(a)) whether or not Léveillé accepted *Microbotryum* at generic rank.) Until 1982 no one had selected a lectotype. Nonetheless, all authors who have treated the genus have apparently assumed the type to be the first of the three cited species even though, for later writers, such autmatic selection is contrary to the International Code of Botanical Nomenclature (ICBN, Art. 8.1(c)). A second order of error exists, comprising the various interpretations of authorship of this species. Saccardo (1888), Zundel (1953), and Deml & Oberwinkler (1982) transcribed it as *Ustilago antherarum* Lév., failing to note that De Candolle is the author of the epithet as acknowledged in Léveillé's (1847) concordance. Similarly Lindeberg (1959) and Deml & Oberwinkler (1982) cited *Ustilago antherarum* Fries, again ignoring De Candolle's authorship of the epithet. Ainsworth & Sampson (1950), Mordue & Ainsworth (1984), and Vánky (1987) correctly assume Fries's name to be a transfer of *Uredo antherarum* DC. and cite it as *Ustilago antherarum* (DC.).

Uredo antherarum DC., however, is a nomen novum illegitimum (Art. 63.1) for *Uredo violacea* Pers. (Ainsworth & Sampson, 1950; Lindeberg, 1959; Mordue & Ainsworth, 1984). Consequently, *Microbotryum antherarum* [DC.] Lév. is also illegitimate. (Article 10 of the Code gives no indication that the type of a generic name must be a legitimate name even though Art. 11 requires that the name be legitimate for ranks from genus to family.) Deml & Oberwinkler's (1982) citation of *M. antherarum* Lév. as the "type" has the effect of making *Uredo antherarum* DC. the lectotype of *Microbotryum*. Subsequently, Prillinger et al. (1991) emended the genus but incorrectly cited *M. violaceum* (Pers.) Deml & Oberw., the correct name for the type species, as the generic type.

An apparently overlooked synonym of *Microbotryum* Lév. is the variant spelling attributed to Schlectendal by Streinz (1862), *Microbotryon*, for a single species *M. antherarum* Schlectendal *in*

Klotzsch, both treated as synonyms by Streinz, and thus not validly published. Despite an intensive literature and herbarium search, R.P. Korf (pers. comm.) has been unable to trace where Streinz found this variant spelling. It is not on the published exsiccati label by Klotzsch. Possibly Streinz saw an annotation on some copy of the exsiccati in one of the herbaria he visited, either misspelled or mistranscribed. Streinz did not pick up Léveillé's generic name, *Microbotryum*.

The nomenclature of *Microbotryum* and *M. violaceum* follows. The symbol ≈ is used to designate *pro synon.* names that are not validly published according to ICBN Art. 34.1(c).

Microbotryum Lév., Ann. Sci. Nat. Bot. III, 8 (**1847**) 372.
≈ *Microbotryon* Schlechtendal **ex** Streinz, Nomencl. Fung. pp. 382, 654, Nov. **1861** [1862] *pro synon.* [not validly published, ICBN Art. 34.1(c)].
Lectotype species: *Uredo antherarum* DC., Fl. fr. 6 (**1815**) 79; nom. nov. illegit. (Art. 63.1) {Basionym: *Uredo violacea* Pers., Tent. Disp. meth. Fung. (**1797**) 57.} : Pers., Syn. Meth. Fung.: 225. **1801**.

Microbotryum violaceum (Pers. : Pers.) Deml & Oberw., Phytopath. Z. 104 (**1982**) 353.
≡ *Uredo violacea* Pers., Tent. disp. meth. Fung. (**1797**) 57: Syn. Meth. Fung. 225 (**1801**).
≡ *Ustilago violacea* (Pers. : Pers.) Roussel, Fl. Calvados, ed. 2, (**1806**) 47.
≡ *Uredo antherarum* DC., Fl. fr. 6 (**1815**) 79; nom. nov. illegit. (Art. 63.1)
≡ *Caeoma antherarum* (DC.) Schlechtend., Fl. berol. 2 (**1824**) 130 (ut *Uredo antherarum* DC.) [not validly published, ICBN Art. 34.1(c)].
≈ *Ustilago antherarum* (DC.) Fries, Syst. Mycol. 3 (**1832**) 518, *pro synon.* (ut *Ur. antherarum* DC.) [not validly published, ICBN Art. 34.1(c)].
≡ *Erysibe antherarum* (DC.) Wallroth, Fl. Crypt. Germ. 2 (**1833**) 217 [not validly published, ICBN Art. 34.1(c)].
≈ *Microbotryum antherarum* (DC.) Lév. **in** Rabenhorst, Klotzschii Herb. Viv. Mycol. Ed. nov. Cent. 1, no. 100, **1859**, (issued as *Uredo antherarum* DC.); (DC.) Lév., *in* Zundel, The Ustilaginales of the World, (**1953**) p. 218; (DC.) Lév. *in* Deml & Oberw., Phytopath. Z. 104 (**1982**) 353; (DC.) Lév. *in* Vánky, Illus. Gen. Smut Fungi (**1977**) p. 66, (all *pro synon.*), all (ut *M. antherarum* Lév.) [all not validly published, ICBN Art. 34.1(c)].

≈ *Microbotryon antherarum* Schlechtendal **ex** Streinz, Nomencl. Fung. pp. 382, 654, Nov. **1861** [1862] (ut *Uredo antherarum* DC.) *pro synon.* [not validly published, ICBN Art. 34.1(c)].

= *Ustilago lychnidis-dioicae* Liro (ut (DC.) Liro), Ann. Acad. Fenn. Sci. A 17 (**1924**) 33 [validly published, ICBN Art. 72, Note 1] [ut *lychnis-dioicae* (DC.) Liro (Deml & Oberw., Phytopath. Z. 104 (**1982**) 353)].

≡ *Uredo antherarum* δ *lychnidis-dioicae* DC., Fl. fr. 6 (**1815**) 79; nom. nud.

≡ *Microbotryum lychnidis-dioicae* (Liro) Deml & Oberw., [ut *lynchis-dioicae* (DC.) Deml & Oberw.] Phytopath. Z. 104 (**1982**) 353.

= *Ustilago silenes-inflatae* Liro [ut (DC.) Liro], Ann. Acad. Fenn. Sci. A 17 (**1924**) 44 [validly published, ICBN Art. 72, Note 1].

≡ *Uredo antherarum* ß *silenes-inflatae* DC., Fl. fr. 6 (**1815**) 79; nom. nud.

≡ *Microbotryum silenes-inflatae* (Liro) Deml & Oberw. [ut (DC.) Deml & Oberw.], Phytopath. Z. 104 (**1982**) 354.

Another nomenclatural correction in *Microbotryum* was made by Denchev (1994).

Many of the genera in the order are restricted to either monocot or dicot hosts; six, however, occur on both types and are most in need of reexamination and molecular analysis. These and the other genera of the order divide to substrate as follows (Zundel, 1953):

DICOTS—*Bauhinus* (Compositae, Dipsaceae, and Polygonaceae); *Glomosporium* (Amaranthaceae, Chenopodiaceae); *Melanopsichium* (Polygonaceae); *Microbotryum* (Caryophyllaceae); *Mundkurella* (Araliaceae); *Mycosyrinx* (Vitaceae); *Pericladium* (Piperaceae, Tiliaceae); *Schroeteria* (Scrophulariaceae); *Ustacystis* (Rosaceae).

MONOCOTS—*Cintractia* (Cyperaceae, Juncaceae, Poaceae); *Cintractiella* (Cyperaceae); *Farysia* (Cyperaceae, Poaceae); *Schizonella* (Cyperaceae); *Testicularia* (Cyperaceae, Poaceae); *Tranzscheliella* (Poaceae).

MIXED—*Sorosporium* (Caryophyllaceae, Cyperaceae, Poaceae, Portulacaceae, Juncaceae, Umbelliferae); *Sphaceotheca* (Poaceae, Polygonaceae); *Thecaphora* (Amaranthaceae, Compositae, Convolvulaceae, Cyperaceae, Leguminosae [Vánky, 1991b], Nyctaginaceae, Poaceae, Restiaceae, Rubiaceae, Solanaceae, Umbelliferae); *Tolyposporella* (Liliaceae, Poaceae, Polygonaceae); *Tolyposporium* (Cyperaceae, Eriocaulaceae, Juncaceae, Myrtaceae, Poaceae, Restiaceae); *Ustilago* (host familes and unassigned dicot species listed in Moore, 1992).

Schroeteria Winter, on Scrophulariaceae (*Veronica* spp.), is traditionally classified in the Tilletiales. The rugose spores, like those of *Neovossia indica* (Mitra) Mundkur, are always multinucleate at the time of germination (Nagler et al., 1989); the ustidia, however, can be extensive and several septate. Each ustidial cell, containing sundry nuclei, may form one or more stout, bottle-shaped cells which generate an indeterminate number of globose sporidia (Vánky, 1981; 1987; Nagler et al., 1989). Nagler et al. (1989) electron microscopically examined *S. delastrina* (L.-R. & C. Tulasne) Winter, the type species, and *S. poeltii* Vánky. The septa of both species have light-dark-light profiles and small pores with sharp rims, about 170 nm and 85 nm in diameter, respectively, and, in some micrographs, pulley-shaped occlusions; the pores are accompanied by small, membrane bounded granules, about 170-250 nm in diameter. The authors, disregarding habit, gross and micromorphology, and the general consensus that this is a natural, well delimited genus of smuts (Vánky, 1981), interpreted the septal granules as Woronin bodies and concluded that these species are ascomycete anamorphs producing conidia rather than sporidia. Unfortunately, they were unable to germinate the ‘phialospores’ and so were unable to demonstrate whether new growth was by basidiomycetous budding or by hyphal growth. Their septal micrographs, however, are consistent with these fungi being ustomycetes. They also state that they never observed the *Ustilago* type of germination (Vánky, 1987; Ingold, 1989) reported by Thirumalachar & Whitehead (1968). Thirumalachar & Whitehead (1968) observed the germination of 100 ustospores and found that “... from each cell a stout germ tube emerged [that] became septate and developed ovate-elliptical, lateral, and terminal sporidia that become separated. These have not been observed to conjugate, but many of them bud off secondary sporidia .... This type of germination is typical of *Ustilago* species .... Schroeter’s description of germination completely agrees with the observations of the authors.” Thirumalachar & Whitehead (1968) merged *Schroeteria* with *Schizonella*, a pathogen of Cyperaceae, because both genera have paired spores.

Vánky (1987) called this an "unfortunate solution" because the two genera differ in biology, sorus characteristics, and spore morphology and germination; to which can be added the difference in host type—dicot vs. monocot.

ConcerningTilletiaria anomala Bandoni & Johri (1972). The species was isolated from decaying wood and is evidently homothallic: ustospores are formed singly within short branches, intercalarily, or in pairs; ustidia are 4-celled; sporidia apiculate, narrow allantoid. The anamorph produces curved ballistospores similar in morphology to the sporidia. The septal pore (Boekhout, 1991) is of the amorphous type (Moore, 1996a) similar to profiles shown for species of, e.g., *Cintractia*, *Cystofilobasidium*, *Tilletiopsis*, and some bunts and smuts. Boekhout et al.'s (1992) data show the coenzyme Q for *T. anomala* to be Q–10. Moore (1980) placed the species in its own family, the Tilletiariaceae, in the Septobasidales; the septal structure, however, indicates that it is better classified in the Ustilaginales.

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RUSSULA SUBALBIDULA - A SOUTHERN SPECIES

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ABSTRACT

Russula subalbidula was reduced to a synonym of *R. anomala* by Singer. Shaffer later concluded that the status of *R. subalbidula* should be reexamined. Examination of a recent collection from Florida confirms that differences do exist so that retention as separate species is warranted.

INTRODUCTION

In November, 1994, a call was received from a fellow member of the New Jersey Mycological Association, Tamara Homer, about a fruiting of a large, peppery tasting, white *Russula* in the grass near live oak at her retreat on Amelia Island, Florida. She returned to New Jersey on December 12 and provided me with several heavy spore prints, two dried specimens, and a fresh collection picked on December 10. This collection proved to be *Russula subalbidula* Murrill and is described below.

MATERIALS AND METHODS

Microscopic descriptions were made from sections mounted in 3% KOH, Melzer's solution and sulphovanillin (SV) solution. Recorded spore sizes exclude ornamentation. Unless otherwise indicated, the massed spore color designated by a capital letter from A to H refers to the spore color code of Pearson (1950).

TAXONOMY

Russula subalbidula Murrill, Mycologia 33:441. 1941.

Pileus 6-15 cm broad, white, shallowly convex with a depressed creamy yellow disc area, glabrous, margin completely even, nonpeeling. Lamellae pale cream, fairly close, equal, brittle, taste moderately acrid but rather long lasting on the tongue. Odor not distinctive. Stipe 3-6 cm long, 13-40 mm thick, white, unchanging on bruising.

Spores in an opaque mass, D or IIc (Romagnesi, 1967), broadly obovate to subglobose, 7-8.5(-9) x 6-7(-7.5)µm, warts mostly 0.6-0.8µm high, conic, some isolated but always a few connectives in the forms of a short band, thin lines, or catenulate chains, but well short of a reticulum, suprahilar area amyloid. Basidia 38-48 x 10-12µm, clavate, 4-sterigmate. Hymenial cystidia 62-100 x 12-17µm, very abundant, on fresh lamellae mostly ventricose, fusoid, fusoid-clavate, many apices appendiculate with the protuberance aciculate and extending 10-25µm, especially on the pleurocystidia, reacting with SV to a rich purple-gray for the complete length. On dried material many of the apices are lost and the remaining cystidial portion becomes more clavate in shape with an uneven, roughened apex. Pileus cuticle thin, gelatinous matrix varying from obvious to sparce, embedded hyphae filamentous, 42-95 x 1.5-3µm, tips acute or rounded, with SV+, cylindrical to clavate, nonseptate pileocystidia 50-70 x 5-11µm and numerous oleiferous hyphae with cylindrical ascendent tips 120± x 4-9µm present. This microscopic data compares favorably with my notes on a collection identified by Murrill at the NY Botanical Garden (NY).

Upon application of SV, both fresh and the recently dried pileus, stipe cuticle and context immediately turn red and soon deepen to maroon. A ferrous sulfate crystal rubbed on the pileus and stipe surface of a fresh cap slowly produces a light grayish green color, not the deep blackish green associated with the *R. xerampelina* complex, nor a trace of the normal pink-salmon-brown color reaction of most Russulas.

MATERIAL EXAMINED: FLORIDA; Alachua Co.; Gainsville, 29 June 1942, Murrill F17287, (NY). Nassau Co.; Amelia Island, 10 December 1994, T. Homer, (RMF personal herbarium).

Observations: Singer (1947) published a redescription greatly expanding Murrill's typically brief description. He indicated the grayish-green reaction with ferrous sulfate but also stated that SV produced a blue reaction on the fresh context. He concluded that *R. subalbidula* must be considered a synonym of *R. anomala* Peck.

In 1989, Shaffer published a redescription of *R. anomala* based on Michigan collections. He noted Singer's conclusion and tended to accept the synonymy after seeing a similarity between the Florida and Michigan dried material. Shaffer noted a red reaction with SV, but because his fresh Michigan collections had produced the normal salmonish ferrous sulfate reaction, he concluded that the status of *R. subalbidula* should be reexamined. In 1990, Shaffer reviewed Peck's type material of *R. anomala* at NYS and illustrated the spores as having isolated to connate warts. He described the type material as being small, under 30mm, and conspicuously striate on the cap margin.

In October 1989, I had looked at the NYS holotype of *R. anomala* which had been collected July 1896 by Peck at Port Jefferson, Suffolk Co., NY. My notes indicate spores of 7.5-8 x 6-7µm with isolated to connate cylindrical warts 0.7-1µm high. The abundant pleurocystidia were still SV+, 10-17µm wide, ventricose, clavate, to mucronate. The pileus epicutis had thin (2-3µm) hyphae and there were many clavate, mostly non-septate, 10µm wide, SV+, pileocystidia as well as narrower cylindrical oleiferous hyphal tips.

This recent collection from Florida confirms the reason for Shaffer's hesitancy in accepting Singer's synonomy in that Florida collections do indeed assume a grayish-green color when treated with ferrous sulfate as reported by Singer. Also, it produced a red reaction with SV as described by Shaffer for *R. anomala* but which Singer had reported "blue on fresh context."!? Other discrepancies which make the synonymy questionable are the absence of a tuberculate-striate margin and the conspicuous amount of wart connectives on this Florida collection as compared to the type of *R. anomala*. Although the two species are microscopically similar, they appear to be distinct. Unfortunately, I have not found fresh material of *R. anomala* and have no collection in my herbarium. Fresh collections of the apparently rare northern material are needed for further study.

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NOTES ON THREE SMALL RED-CAPPED RUSSULAS

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ABSTRACT

Descriptions of the type collections of *Russula pusilla* and *R. operta* are recorded. Fresh collections of *R. fontqueri* and *R. operta* are described. In the field the three are confusingly similar but they can easily be microscopically distinguished and should be considered as distinct species.

INTRODUCTION

In 1957, Singer published a redescription of *Russula pusilla* Peck in which he seems to have greatly expanded its species concept by describing a South Florida form, a Florida summer form I, a Florida summer form II, a Florida winter form, and a northern form. He synonymized several of Murrill's species and in the northern form included *R. operta* Burlingham. The fact that Burlingham (1924) had specifically stated that the context was slowly peppery and in this respect was different from the mild *R. pusilla,* did not deter him, probably because in most of his descriptions he states that the taste of the very fresh young lamellae is slightly peppery and it was not until the cap matured that it became mild. Since Burlingham was already deceased, she had no chance to rebut his synonymizing as she had previously often done. Hesler's (1960,1961) type studies did not depict any great difference between the *R. pusilla* and *R. operta* types and he apparently accepted Singer's synonymy since he did not distinguish between them in his unpublished Russula keys.

In New Jersey and northeastern North America, many collections are made of a small (3± cm), mild *Russula* with a pileus colored some shade of red, peeling 2/3-3/4, a white stipe, lamellae maturing to a deep cream or pale ochre, and yellowish spores. Unless unusual care is taken in obtaining a spore print, the small caps tend to dry quickly and usually only a light print is secured, but enough to indicate a definite yellow-cream color rather than white. Many of these collections have ended up being referred to *R. pusilla.* They have spores 7-9 x 5.5-7µm , warts 0.4-1µm high, isolated or with fine lines connecting 2-6 warts. Singer indicated that the northern form has spores 8.5-11 x 6.5-9µm, warts 0.7-0.9µm high, isolated, or with several fine line connectives (although one of the Florida forms has warts 0.5-1.7µm and wart height is probably included in his spore size). Hesler (1960) reported the spores on the type to be 7.5-9 x 5.5-7µm, warts 0.4-0.6µm, isolated, often with some fine line connectives. The epicutis of the pileus contains clavate, septate pileocystidia.

In 1993, I determined the massed spore color of several closely related small specimens to see if I could distinguish between *R. humidicola* Burl., which Burlingham (1915) described as maize-yellow (Singer's (1942) redescription indicated between C and D) and *R. pusilla* with its original description of yellowish (Singer's redescription of C to D (Crawshay,1930)). Prints from many caps were taken using additional moisture to prevent premature drying and heavy prints were obtained. These were massed after allowing some time for drying. *Russula humidicola* had a color of E-F (Pearson,1950) or IIIa (Romagnesi,1967). The specimens which were assumed to be *R. pusilla* produced a color between F and G or IIIc and IVc, thereby presenting a problem. Therefore, the type collections for *R. pusilla* at NYS and *R. operta* at NY were studied in detail. The collections which produced the F-G colored spores had microscopic characteristics which precluded an association with either *R. pusilla* or *R. operta.* No description of an american species fitting all of the macro- and microscopic diagnostic features could be found. In Romagnesi's text, however, a very nice fit was made with *Russula fontqueri* Singer. My observations of the three preceding species follow:

MATERIALS AND METHODS

Color terms and designations used in the following descriptions are cited from Maerz & Paul (1930) when designated as M&P 4J6 or from the ISCC-NBS system (Kelly & Judd, 1955) when of the form, number, modifier, hue, e.g., 15 moderate red, otherwise they reflect the author's color concept. Microscopic descriptions were made from sections mounted in 3% KOH, Melzer's solution and sulphovanillin (SV) solution. Recorded spore sizes exclude ornamentation. Unless otherwise indicated, the massed spore color designated by a capital letter from A to H refers to the spore color code of Pearson (1950).

TAXONOMY

Russula pusilla Peck, Ann. Rep. N.Y. State Mus. 50:99. 1897.

Pileus cuticle inspected with 10x magnification appears glabrous, uniformly mat, not areolate or separated in any way, and at the margin, a fairly clean bright red in the area of M&P 3J10 or approximately 15 moderate red. The collection may have been made before maturity since the gills are not as pruinose with spores as are most dried specimens. Spores many seem immature, small and not completely decorated with warts. Those which appeared most mature were 6.5-8 x 5.5-6.5µm, elliptic to obovate, had warts 0.3-0.6(-0.8)µm high, mostly isolated or connate, a few fine lines connecting 2-5 warts, prominent amyloid suprahilar area. Basidia 30-35 x 9-11µm, clavate, 4-sterigmate. Hymenial cystidia indiscernible, with little contents reacting in SV; however, they are discernible in KOH, 40-55 x 8-12µm, clavate, many capitellate, upper third empty, lower portions with refractive patches. Pileipellis with hyphal ends 25-50 x 2-4µm, with rounded or acute terminal cells; pileocystidia intermixed clavate, 0-2 septate, 35-65 x 4-9µm with areas of refractive SV+ contents.

MATERIAL EXAMINED: NEW YORK; Suffolk Co.; Port Jefferson, July 1896, Peck, holotype, (NYS).

Russula operta Burlingham, Mycologia 16:18. 1924.

Pileus cuticle inspected with 10x magnification is mat and dark in disc area but in approaching the margin, breaks up into minute patches of pulverulent flocci with the color shading to an incarnate hue in the area of M&P 5A10 or 39 grayish reddish orange. Spores 6.5-8(-9) x 5.5-7(-7.5)µm, broadly obovate to elliptic, warts 0.5-0.8µm high, finely conical, isolated or connate, suprahilar area weakly amyloid. Basidia 35-37 x 9-12.5µm, clavate, 4-sterigmate. Hymenial cystidia when viewed in SV are not very abundant, only random areas contain reactive material with few partial outlines visible, in KOH seen to be versiform in shape, 42-62 x 7-10µm, from clavate, fusoid, to constricted cylindrical, some capitellate or appendiculate, empty or with random refractive areas, the cheilocystidia displaying the greatest diversity of form, the pleurocystidia being mostly capitellate subclavate. Pileus epicutal hyphae ciliate, a trichoderm of chains of inflated, constricted septate cells, 10-30 x 3-10µm, the narrowest at the apex, pileocystidia clavate to ventricose or cylindrical, 0-3 constricted septate, 35-75(-105) x 6-12µm, containing random areas of a refractive, SV+ substance.

MATERIAL EXAMINED: VERMONT; Windham Co.; Newfane Hill, Burlingham 83-1920, annotated holotype by Bills 1984, (NY).

Description of fresh material: Pileus 3-4 cm, disc a dark purplish red shading to pink at the pulverulent speckled margin, dry, margin even, aging short tuberculate-striate, peeling about 3/4 of the radius. Lamellae cream, brittle, somewhat close, a very few forked, not necessarily at the base, a few long lamellulae present, taste slowly slightly or faintly peppery. Odor nil. Stipe 3-4 x 0.5-1 cm, white, unchanging when bruised. Spores in mass E (pale-ecru t.2 in Burlingham's description). Found under oak.

Spores 6.5-7.5(-8) x 5.5-6µm, broadly obovate to elliptic, warts 0.4-0.7 µm high, mostly isolated, few short catenulate chains, suprahilar area weakly amyloid. Basidia 35-40 x 10-12.5µm, clavate, 4-sterigmate. Pleurocystidia 45-60 x 8-12µm, capitellate clavate, upper 2/3 staining medium gray in SV. Cheilocystidia appendiculate, clavate to constricted cylindrical, some with empty areas not reactive with SV. Pileus epicutis without gelatinous material, a trichoderm of ciliate hyphae, ends 45-60 x 3-9µm, consisting of 3 to 5 constricted septate cells, the end cell with a rounded apex 3-5µm wide, pileocystidia clavate, 25-60 x 5-8µm, 0-3 slightly constricted septate, strongly graying in SV, a few cylindrical 100± x 6.5µm, 3 septate, SV+ shapes seen which may be ascendant tips of the oleiferous hyphae present in the subcutis.

MATERIAL EXAMINED: MASSACHUSETTS; Worcester Co.; Upton State Forest, 14 August 1993. NEW JERSEY; Somerset Co.; Hutcheson Memorial Forest, 20 June 1991, (All in RMF personal Herbarium).

Observations: *Russula operta* is apparently a fairly scarce taxon since my herbarium contains only two collections. Notes on these collections are the basis for the above description of fresh material. One was obtained at the August 1993 NorthEast Mycological Foray (NEMF) at Southborough MA where it mistakenly was recorded as *R. melzeri* Zvara ss JulSchff. which has similar spores and cuticle but a G spore print color. The other was collected under oak at Rutger's Wm. L. Hutcheson Memorial Forest, Somerset County, NJ on 6-20-91 and was filed as unk.#40. The taste of this taxon is troublesome. If tasted while also checking other peppery species, it passes as being mild. Yet, when tasted by itself, as my notes indicate, a weak peppery after taste slowly develops so it is not completely mild. Burlingham's description used the phrase "slowly peppery". She also commented that "The acridity seems to be located in the pileus and becomes very evident when one chews the entire pileus. In old specimens the taste may be nearly mild." Macroscopically the uniform glabrous cuticle in the marginal area of *R. pusilla* can be used to distinguish it from the patchy, pulverulent, subareolate cuticle of *R. operta*. Microscopically the trichoderm of wide ciliate hyphae which form the pileal epicutis of *R. operta* readily distinguishes it from *R. pusilla* with its much narrower filamentous epicutal hyphae. The cuticular hyphae are so markedly different that these must be considered distinct species. The massed spore colors of the two species are similar. In Crawshay's spore color system, normally used by Singer, C to D corresponds closely to D to E (Pearson) according to an excellent analysis and correlation of the various *Russula* spore color charts done by R. W. Rayner (1985).

Russula fontqueri Singer sensu Romagnesi, Les Russules d'Europe et d'Afrique du Nord. p.635. 1967.

Pileus 2-5 cm, convex young to slightly depressed disc at maturity, color when young and on the disc at maturity, a deep dull red best represented by hues in the area of M&P 5K5 or 15 moderate red to M&P 5K11 or 37 moderate reddish orange, shading at the margin in age to a pale reddish salmon in the area of M&P 5F9 or 30 dark yellowish pink, or lighter and yellower; surface mat and glabrous while young but the expanding marginal area becoming asperulate in age with minute pulverulent flocci, viscid when wet, noticably tuberculate-striate for at least 1/3 of the radius, peeling about 3/4 of the radius. Lamellae cream becoming pale ochre, brittle, subdistant, mostly equal with an occasional basal fork or with a few long lamellulae; taste mild; odor nil. Stipe 2-4 x 0.5-1 cm, white or slightly yellowing in age, often slightly enlarged towards the base, stuffed, very fragile, unchanging when bruised; 10% ferrous sulfate produces the normal light tannish salmon color.

Spores in mass F-G or IIIc to IVa, 7-8(-8.5) x 5.5-6.5µm, elliptic to broadly obovate, warts 0.5-0.8(-1)µm high, conical to cylindrical, connectives noticeable as short catenulate chains or bands and fine lines, without forming a reticulum, suprahilar area prominently amyloid. Basidia 35-37 x 10-12µm, clavate, 4-sterigmate. Hymenial cystidia 45-60 x 7.5-10µm, ventricose to clavate, capitellate, SV+ mostly in upper 1/2-2/3. Pileus epicutis an ixotrichoderm, the hyphal ends 30-70 x 1-4µm, usually two non-constricted septa visible in that length, apices rounded to acute, pileocystidia 30-90 x 5-7µm, clavate to subcylindrical, 0-3 septate, some constricted, with SV+ contents.

Isolated to gregarious under hardwoods, usually in grass or duff under oaks. June to August.

MATERIAL EXAMINED: MAINE; Penobscot Co.; University of Maine campus, Orono, 18 July 1988. RHODE ISLAND; Washington Co.; University of RI campus, Kingston, 6 August 1988. NEW JERSEY; Mercer Co.; Washington Crossing State Park, 16 July 1989. Somerset Co.; Rutger's Hutcheson Memorial Forest, 22 August 1990. Hillsborough, 16 June 1985, 19 August 1992, 16 August 1993, 3 July 1994, (All in RMF personal herbarium).

Observations: Romagnesi commented that while Singer's description indicated a cap size of 4.5-6 cm., and a stipe usually with pink coloration towards the base although a completely white stipe also could occur, the form normally collected was smaller, with a cap size of 2.7-4 cm and a white stipe. Macroscopically, *R. fontqueri* and *R. operta* are very similar. The deeper spore print color of F to G, the prominent wart connectives, and the slender hyphae in the gelatinized matrix of the pileus cuticle of *R. fontqueri* are diagnostic features that will readily separate it from *R. operta* with its paler spore color of E, spores with predominantly isolated warts, and distinctive pileal epicutal trichoderm of constricted septate (ciliate) hyphae.

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MYCOTAXON

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A NEW SPECIES OF *PERICONIELLA* ON *POMADERRIS*

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Pomaderris (family Rhamnaceae) is an Australasian genus of about 40 species of shrubs and trees. A speckle on the upper surface of living leaves of *P. kumeraho* A. Cunn., a shrub which grows in the north of New Zealand, was found to be accompanied by a mould growth on the lower surface of the leaves. The mould is an undescribed species of *Periconiella*.

Periconiella pomaderridis McKenzie sp. nov. Fig. 1.

Coloniae hypophyllae. Mycelium partim intermum et extermum, ex hyphis pallidis, ramosis et anastomosantibus, laevibus, septatis, 1.5-3.5 µm crassis. Stroma nullum. Conidiophora apicalia et lateralia, macronematosa, mononematosa, solitaria. Stipites erecti, recti vel flexuosi, laeves, septati, brunnei, apicem versus pallidiora, usque ad 300 µm longi x 5-6.5 µm crassi. Rami brunnei, flexuosi, usque ad 100 µm longi x 4.5-6 µm crassi. Cellulae conidiogenae polyblasticae, in conidiophoris incorporatae, terminales et intercalares, sympodiales, cicatrices conidiales 2-2.25 µm latae. Conidia solitaria, acropleurogena, pallide brunnea, laevia, (0-) 1-3 (-5) septata, non constricta, recta vel parum flexuosa, cylindrica, (13.5-) 20-45 (-50) µm longa x (3.5-) 4-5.5 (-6) µm lata; cellula apicalis rotundata, cellula basalis rotundata; hilo 2-2.25 µm lato.

In foliis rhamnaceae speciei *Pomaderris kumeraho* A. Cunn.
Holotypus PDD 63799.

Colonies hypophyllous. Mycelium superficial and immersed, pale, branched and anastomosing, smooth, septate, 1.5-3.5 µm thick. Stroma absent. Conidiophores arising terminally and laterally on the hyphae, macronematous, single, composed of a mononematous stipe and a head of branches bearing conidia. Stipes erect, straight or flexuous, smooth, septate, brown, paler towards the apex, up to 300 µm long x 5-6.5 µm thick. Branches brown, flexuous, up to 100 µm long x 4.5-6 µm thick. Conidiogenous cells polyblastic, integrated, terminal becoming intercalary, sympodial, conidial scars prominent, 2-2.25 µm wide.

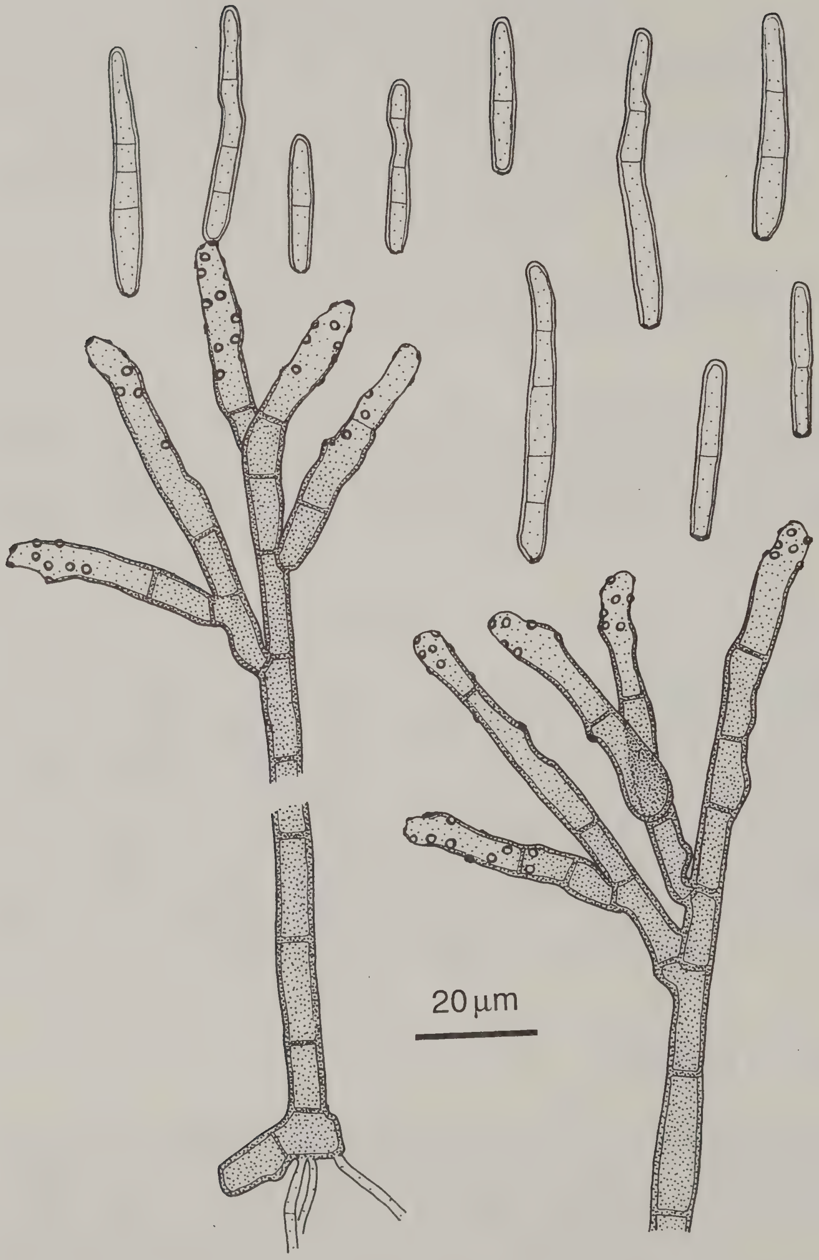

Figure 1. *Periconiella pomaderridis*, conidiophores and conidia of type (PDD 63799) from host. Specimen mounted in hydrous lactophenol.

Conidia solitary, acropleurogenous, pale brown, smooth, (0-) 1-3 (-5) septate, non-constricted, straight or slightly flexuous, cylindrical, apex and base rounded, (13.5-) 20-45 (-50) x (3.5-) 4-5.5 (6) µm; hilum 2-2.25 µm thick.

On living leaves of *Pomaderris kumeraho* A. Cunn.
Sporulation is usually associated with an indistinct yellowish or reddish-brown speckle on the upper leaf surface.

Specimen examined: New Zealand, Northland, Te Paki, Shenstone Block, 26.I.1995, R.E. Beever (PDD 63799 - holotype).

Periconiella pomaderridis is distinct from other *Periconiella* species with multiseptate, non constricted, smooth, and cylindrical conidia. Of these, *P. banksiae* Priest (1991) has shorter conidia (6-30 µm) and smaller conidiophores (stipe up to 160 µm long), while *P. triseptata* (Bat. & J.L. Bezerra) M.B. Ellis (1971) has shorter conidia (13-26 µm), sometimes formed in chains and with a distinctive conico-truncate base.

There are six species of *Periconiella* known from New Zealand, all associated with native plants. Of these, *P. araliacearum* G.F. Laundon (1971) on *Pseudopanax arboreus* and *Schefflera digitata*, *P. coprosmae* G.F. Laundon (1971) on *Coprosma grandifolia*, *P. cordylines* McKenzie (1990) on *Cordyline banksii* Hook. f., and *P. phormii* M.B. Ellis (1967) on *Phormium cookianum* and *P. tenax* are pathogens causing either a leaf speckle or a leaf mould. Only *P. liberatas* McKenzie (1982), associated with dead leaves of *Chionochloa* spp., appears to be saprophytic.

Acknowledgment

I thank Dr M.J. Priest, NSW Agriculture, Rydalmere, Australia for critical review of this paper, and Dr Ross Beever, Landcare Research, Auckland who collected the fungus and brought it to my attention. Funds for this research were provided by the Foundation for Research, Science and Technology under contract number C09309.

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THE LICHEN GENUS **LECANACTIS** AND ALLIED GENERA IN PAPUA NEW GUINEA

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Abstract.- The material belonging to **Ancistroporella**, **Bactrospora**, **Catarraphia**, **Cresponea**, **Lecanactis** and **Lecanographa** and recently collected in Papua New Guinea has been studied. Two species are described as new for science: **Cresponea apiculata** Egea, Sérusiaux & Torrente, and **Lecanactis olivascens** Egea, Sérusiaux & Torrente. The following species are reported as new for that country: **Catarraphia dictyoplaca**, **Cresponea leprieurii**, **C. leprieurioides**, **Cresponea macrocarpoides**, and **Lecanactis abietina**.

In 1992, A. Aptroot, P. Diederich, E. Sérusiaux and H. Sipman spent five weeks in Papua New Guinea, collecting lichens and lichenicolous fungi from various parts of the country: along the northern coast in the Madang province, in the mountains of the Huon peninsula (Madang province), and in the mountains from

Goroka to the Mt Wilhelm area in the Eastern Highlands and Simbu provinces. Several thousand specimens were gathered, amongst which several belong to **Lecanactis** and allied genera (sensu Egea & Torrente 1994:50-51). The study of that material was entrusted to one of the collectors (ES) and to the world specialists of that group (JME & PT). A few further specimens were also available, collected either by A. Aptroot and H. Sipman during an earlier (1987) field trip to the country, or by other lichenologists (P.W. Lambley and H. Streimann).

A set of representative collections is deposited in UPNG (Herbarium of the University of Papua New Guinea at Port Moresby).

Ancistroporella australiensis (Thor) Thor

Eastern Highlands prov., Mount Gahavisuka Provincial Park, 11 km N of Goroka, 145°25'E 6°01'S, 2300 m, on tree in forest remnants, 3.1987, *A. Aptroot* s.n. (herb. Aptroot). Ibid., mossy mountain forest, 2300-2450 m, on tree, 8.1992, *A. Aptroot* 31081 (herb. Aptroot) & *P. Diederich* 10579 (herb. Diederich).

This species, the only one so far described in the genus, is known from Queensland/Australia where it grows at mid-elevation (less than 1000 m) in rain forests, and in Papua New Guinea, where it has been found in a mossy mountain forest at a higher elevation. Its presence in Papua New Guinea was first mentioned by Egea & Torrente (1994:173).
See Thor (1990: 30-32) and Egea & Torrente (1994: 172-173) for a full description and illustrations.

Bactrospora leptoloma (Müll. Arg.) Egea & Torrente

Madang prov., Manam island, in plantation near Budua, 145°00'E 4°07'S, 50 m, on tree, 7.1992, *A. Aptroot* 30472 (herb. Aptroot). Near Bogia, Laing Island in Hansa Bay, 1 m, 144°52'E 4°10'S, epiphyte in coastal forest on coral island, 7.1992, *A. Aptroot* 30196 (herb. Aptroot), *P. Diederich* 11602 (herb. Diederich), *H. Sipman* 34756a (B).

Egea & Torrente (1993a:240) pointed out that the ascospores are of the *Patellarioides* -type when young, becoming of the *Jenikii* -type at maturity, and measure 3-3.5(-4) µm in width. In the specimens here investigated, the ascospores always belong to the *Jenikii* -type, and reach 4(-4.5) µm in width. They are nevertheless considered as conspecific with the type, the only other collection available.
Besides these collections from the northern coast of Papua New Guinea, the species is known only from the type locality on Victoria Island, between Singapore and Sarawak (Malaysia). In Papua New Guinea, it was found on trees in little disturbed coastal forests and in plantations, also near the coast. The above collections are already mentioned in Aptroot & al. (1995:25).
See Egea & Torrente (1993a: 240) for a full description and illustrations.

Bactrospora metabola (Nyl.) Egea & Torrente

Madang prov., Laing Island in Hansa Bay, 144°52'E 4°10'S, 1 m, epiphyte in coastal forest on coral island, 7.1992, *E. Sérusiaux* 13090 (LG) and *H. Sipman* 34762 (B). Mouth of the river Boroi, mangrove forest, 7. 1992, *A. Aptroot* 30413 (herb. Aptroot). Tongu, along the road Bogia-Josephstaal, secondary forest near a village, 330 m, on *Intsia*, 7.1992, *A. Aptroot* 30660 (herb. Aptroot).

This species is recorded from Andaman Island (India), New Caledonia, New Zealand, and Papua New Guinea. In the last country, it was found on trees in a mangrove, in a little-disturbed coastal forest and in a secondary forest in low hills. The above collections are already mentioned in Aptroot & al. (1995:25).
See Egea & Torrente (1995: 58) for a full description and photographs.

Catarraphia dictyoplaca (Mont. et v. d. Bosch) Massal.

Central prov., Varirata National Park, path up to Gaires lookout, 147°22'E 9°27'S, 800 m, on *Gnetum*, 9.1987, *P. W. Lambley* (BM). Madang prov., foothhills of Finisterre Range, along road Madang-Lae, km 39, 145°34'E 5°25'S, 230 m, rainforest on low hills, 8.1992, *E. Sérusiaux* 14301 (LG).

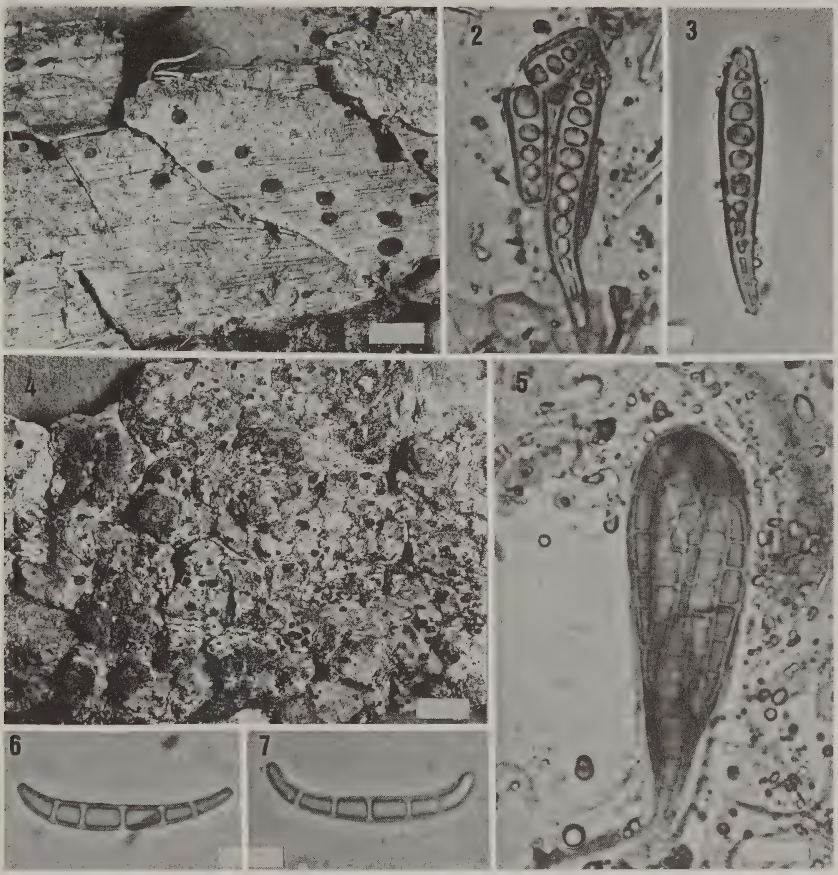
The ascospores of this species, the only one so far in the genus, are provided with mucilagenous attenuated appendages, 5-10 x 2-4 µm, at both ends. These appendages were described as germinating tubes by Egea & Torrente (1993b:330) but the recently collected material shows that these structures are better interpreted as genuine appendages.
This species is known from Indonesia/Java and the Moluccas Islands, Luzon Island in the Philippines and Fiji. There is also an unpublished record from Malaysia/Sarawak (B. J. Coppins, comm. pers.). It is new for Papua New Guinea, where it has been found on both coasts, in virgin rainforests, at mid and low elevations.
See Egea & Torrente (1993b:329) for a full description and illustrations.

Cresponea apiculata Egea, Sérusiaux & Torrente sp. nov.
Fig. 1-3.

Thallus crustaceus, tenuis, effusus, pro maxima parte endophloeodes. Ascomata sessilia ad basin constricta, rotundata vel leviter irregularia, 0.5-1.3 mm in diam. Margo niger, crassiusculus, prominulus, plus minusve crenulatus. Discus primum rufescenti-pruinosus, demum nudatus et niger. Excipulum integrum carbonaceum. Paraphysoides simplices vel leviter ramosae, 1.5-2 µm crassae. Asci fissitunicati, 95-110 x 19-21 µm, octospori. Endoascus structura annulari amyloidea instructus. Ascosporae hyalinae, fusiformes, altera extremitate rotundata, altera attenuata, 45-56(-58) x (6-)7-9 µm, 10-13-septatae, non halonatae.

Typus: Papua New Guinea, Madang prov., Manam island, near Bogia, in gardens near Budua, 145°00'E 4°07'S, 50 m, 7.1992, *E. Sérusiaux* 13250 (LG- holotypus; MUB, UPNG-isotypi).

Thallus crustose, thin, mostly endophloeodal, greenish, effuse, without prothallus.
Ascomata apothecioid, sessile, with a constricted base, 0.5-1.3 mm in diameter, scattered or crowded, roundish or slightly contorted through mutual pressure. Margin lecideoid, prominent, smooth or crenulate, persistent, glossy black, epruinose. Disc



Cresponea apiculata Egea, Sérusiaux & Torrente (holotype). Figs 1-3. 1: General habit, scale = 3 mm; 2-3: Ascospores, scale = 10 μm. **Lecanactis olivascens** Egea, Sérusiaux & Torrente (holotype). Figs 4-7. 4: General habit, scale = 3 mm; 5: Mature ascus with spores (after K/I treatment), scale = 10 μm; 6-7: Ascospores, scale = 10 μm.

plane or slightly convex, with a reddish brown pruina, becoming epruinose at maturity. Excipulum well developed, dark brown to carbonaceous, K+ dark green or olive brown, composed of conglutinate, thick-walled hyphae, closed at the bottom and extending down towards the medulla or substratum. Hymenium hyaline, 120-130 μm thick, I+, K/I+ blue. Subhymenium hyaline to pale brown, 40-60 μm, I+ blue. Paraphysoids simple or sparsely branched, with few or no anastomoses, 1.5-2 μm wide; apical cell of paraphysoids clavate, with a distinct red to dark brown cap which is formed in the outer part of the cell wall. Asci fissitunicate, clavate to cylindrical-clavate, with a short stipe, 95-110 x 19-21 μm, 8-spored, hemiamyloid (K/I+ blue), with an easily distinguishable ring structure and a small ocular chambre (*Abietina* -type, sensu Torrente & Egea 1989:31-32). Ascospores hyaline, fusiform, at the upper end roundish and at the lower end tapering into a narrow apex, 45-56(-58) x (6-)7-9 μm, 10-13-septate, thick-walled and widened at septa, with a smooth surface and without a distinguisable gelatinous sheath.
Pycnidia not found.
Chemistry: Thallus K-, C-, KC-, P-. No substances detected by TLC.

Distribution and habitat: Known only from the Madang province in Papua New Guinea, where it is corticolous in secondary forests or in plantations near the coast.

Notes: **Cresponea apiculata** is the only species of the genus with ascospores tapering towards one end in a narrow apex. This character, together with the size and the widened septa of the ascospores, distinguish it from the closely related **C. plurilocularis** (Nyl.) Egea & Torrente which has shorter ascospores, and **C. leprieurii** (Mont.) Egea & Torrente which has ascospores with not or slightly widened septa (Egea & Torrente 1993c).

Additional specimens examined: Madang prov., Manam island, in plantation near Budua, 145°00'E 4°07'S, 50 m, on tree, 7.1992, *A. Aptroot* 30470, 30471 (herb. Aptroot). Big Pig island near Madang, 145°50'E 5°10'S, secondary forest on coral island, 1 m, on *Cocos*, 8.1992, *A. Aptroot* 31887 (herb. Aptroot) and *H. Sipman* 36188 (B).

Cresponea flava (Vain.) Egea & Torrente

Madang prov., Karkar island, NW side, in gardens near the Karkar District School, 145°57'E 4°34'S, 10 m, on trunks of *Cocos* palms in garden, 2.1987, *H. Sipman* 24198 (B). Madang city, 145°45'E 5°15'S, 1 m, on trunks of trees in park,7. 1992, *P. Diederich* 11756 (herb. Diederich). Big Pig island near Madang, 145°50'E 5° 10'S, 1 m, secondary forest on coral island, on *Cocos*, 8.1992, *A. Aptroot* 31880 (herb. Aptroot). Foothills of the Finisterre Range, along road Madang-Lae, km 39, 145° 34'E 5°25'S, 230 m, rainforest on low hills, 8. 1992, *P. Diederich* 12120 (herb. Diederich).

This species has a pantropical distribution, and was previously recorded from Papua New Guinea, in Karkar island (Madang prov., on the northern coast) and near Port Moresby (Central prov., on the southern coast).
See Egea & Torrente (1993c: 314) for a full description.

Cresponea leprieurii (Mont.) Egea & Torrente

Eastern Highlands prov., Mount Gahavisuka Provincial park, 11 km N of Goroka, along trail to lookout, 2300-2450 m, 145°25'E 6°01'S, little disturbed mossy mountain forest, 8.1992, *H. Sipman* 35500 (B).

This species has a mainly Neotropical distribution, but is also recorded from Queensland (Australia). It is new for Papua New Guinea, where it was collected in a mossy mountain forest in the central cordillera.
See Egea & Torrente (1993c: 317) for a full description.

Cresponea leprieurioides (Nyl.) Egea & Torrente

Madang prov., mouth of Boroi river near Borgia, N-point of island, 144°47'E 4°04'S, 1 m, mangrove forest, on *Rhizophora* or on unidentified tree, 7.1992, *A. Aptroot* 30422 (herb. Aptroot), *P. Diederich* 11671 (herb. Diederich), *E. Sérusiaux* 13203 (LG) and *H. Sipman* 34852 (B).

This species is easily identified by its leprarioid, C+ reddish thallus. It was only known from the type locality in Malacca (Malaysia/Malaya peninsula); it is therefore new for Papua New Guinea.

See Egea & Torrente (1993c: 319) for a full description.

Cresponea macrocarpoides (Zahlbr.) Egea & Torrente

Madang prov., Huon Peninsula, Finisterre range, Teptep village, 2500 m, 7.1992, *P. Diederich* 10972 (herb. Diederich).

Taxon characterized by its narrow ascospores with 7-10(-11) septa. It was only known from the type locality in Taiwan (Mt Arisan) and therefore is new for Papua New Guinea.
See Egea & Torrente (1993c: 320) for a full description and illustrations.

Cresponea proximata (Nyl.) Egea & Torrente

All specimens from the Madang prov. Near Bogia, 3 km on road from Nubia to Bunapas, 144°49'E 4°11'S, 10 m, swampland with medium forest, on tree, 7.1992, *A. Aptroot* 30278 (herb. Aptroot). Ibid., 5 km on road from Nubia to Bunapas, 144°48'E 4°11'S, 10 m, on fallen forest tree along the road, 7.1992, *H. Sipman* 34837 & 34838 (B). Near Bogia, coastal forest E of Boroi river mouth, 144°48'E 4°06'S, 1 m, rainforest c. 50-500 m from the beach, 7.1992, *P. Diederich* 11828 (herb. Diederich), *E. Sérusiaux* 13350 (LG) and *H. Sipman* 34948, 35017 (B). Ibid., mouth of Boroi river near Bogia, N-point of island, 144°47'E 4°04'S, 1 m, mangrove forest, on *Rhizophora* or on unidentified trees, 7.1992, *A. Aptroot* 30403, 30419 (herb. Aptroot), *P. Diederich* 11669, 11670, 11736 (herb. Diederich), *E. Sérusiaux* 13201 (LG) and *H. Sipman* 34870 (B). Laing Island in Hansa Bay, 144°52'E 4°10'S, 1 m, epiphytic in coastal forest on coral island, 7.1992, *E. Sérusiaux* 13089 (LG) and *H. Sipman* 34765 (B). Along road Bogia-Josephstaal, near Tongu church, 144°56'E 4°27'S, 330 m, on trunk and in canopy of a felled tree in gardens, 7. 1992, *Diederich* 11468 (herb. Diederich). Manam island, on trail along riverbed 500 m W of Dugulaba, 145° 01'E 4°06'S, in clearing on lower border of mountain forest, 450 m, 7.1992, *A. Aptroot* 30498 (herb. Aptroot). Burbura logging site, c. 35 km NNW of Madang, 145°38'E 4°48'S, 50 m, virgin rainforest on low hills, 7.1992, on tree, *P. Diederich* 11944 & 11945 (herb. Diederich). Krangket island near Madang, 145°49'E 5°12'S, coastal forest on coral island, 1 m, on tree, 8. 1992, *A. Aptroot* 31850 (herb. Aptroot). Foothhills of Finisterre Range, along road Madang-Lae, km 44, 145°33'E 5°26'S, 150 m, virgin floodplain forest along Nuru river, on sapling, 8.1992, *A. Aptroot* 31791 (herb. Aptroot) and *H. Sipman* 36108, 36150 (B). Gogol valley, Tgubi logging site, 30 km W of Madang, 145°28'E 5°08'S, 125 m, virgin floodplain forest along Gogol river, on tree, 8.1992, *A. Aptroot* 32900, 32942 (herb. Aptroot), *P. Diederich* 12081 (herb. Diederich) and *E. Sérusiaux* 14250 (LG), and *H. Sipman* 36007 (B). Ramu valley Brahman, along road to Bundi, 145°21'E 5°46'S, 200 m, virgin lowland rainforest, on *Dipterocarpus* trees, 8.1992, *A. Aptroot* 31688 (herb. Aptroot).

This taxon has a pantropical distribution and is the most commonly encountered species in lowland virgin and secondary forests along the northern coast of Papua New Guinea. It was reported for the first time from this country by Aptroot & al. (1995:27).
See Egea & Torrente (1993c: 328) for a full description and illustrations.

Lecanactis abietina (Ach.) Körber

Madang prov., Huon Peninsula, Finisterre range, Yupna valley, Teptep village, 146°33'E 5°57'S, 2300-2650 m, disturbed mountain forest with scattered old trees, 30.7.1992, *E. Sérusiaux* 13621 (LG).

Our specimen matches quite well the northern populations of this well-known species; however, the pruina of the pycnidia is C-, a character also found in specimens from the Pacific coast of North America.
This species is quite common in northern and central Europe, as well as along both coasts of North America. In the southern hemisphere, it is recorded from Tasmania and New Zealand. This is the first report for tropical areas.
See Egea & Torrente (1994: 56) and Tehler (1990: 2477) for a full description.

Lecanactis olivascens Egea, Sérusiaux & Torrente sp. nov.
Fig. 4-7.

Thallus crustaceus, griseoalbus, effusus, pro maxima parte epiphloeodes. Ascomata sessilia ad basin constricta, rotundata vel leviter irregularia, 0.4-0.6 mm lata, olivaceus. Paraphysoides ramosae et anastomosantes, usque ad 2 μm crassae. Asci fissitunicati, 60-75 x 18-20 μm, octospori. Endoascus structura annulari amyloidea instructus. Ascosporae hyalinae, fusiformes, 32-36 x 3.5-5 μm, 5-septatae, non halonatae.

Type: Papua New Guinea, Eastern Highlands prov., Mount Gahavisuka Provincial park, 11 km N of Goroka, 2300-2450 m, 145°25'E 6°01'S, 2300-2450 m, mountain forest, on tree, 8.1992, *A. Aptroot* 32433 (B-holotypus; LG, UPNG, herb. Aptroot-isotypi).

Thallus crustose, greyish white, effuse, continuous to slightly cracked, with smooth surface, surrounded by a thin, brown prothallus. In section up to c. 100 μm thick, composed of a plectenchyma with a cretaceous medulla; hyphae 3-4 μm in width, with numerous crystals on their outer walls.

Ascomata apothecioid, circular or slightly irregular in outline, 0.4-0.6 mm in diam., scattered or in groups of 4-5, sessile but with a constricted base, with a typically olivaceous disc, with a fluffy surface at high magnification (40 x). Margin thin, not raised above the level of the disc. Excipulum well developed, dark brown, K+ green-olive, especially at its outer margins, mainly composed of branched and interwoven hyphae, easily seen when mounted in a KOH solution. Hymenium 100-130 μm high, I+ pale blue at the base, K/I+ blue. Subhymenium 20-30 μm high, pale brown, K + slightly paler. Paraphysoids branched and anastomosing, 1.5-2 μm wide in the hymenium; apical cells of paraphysoids slightly widened and richly branched, wrapped in a dark brown amorphic mass, K + olive-brown or greenish-olive, and irregularly protruding out of the disc surface and thus forming the fluffy surface seen at high magnification. Asci cylindrical-claviform, belonging to the *Abietina* -type (sensu Egea & Torrente 1994:21), 60-75 x 18-20 μm, fissitunicate, 8-spored. Ascospores hyaline, fusiform, tapering towards one end, 32-36 x 3.5-5 μm, 5-septate, slightly curved, thin-walled and without a distinct gelatinous sheath.

Pycnidia immersed or semi-immersed in the thallus, punctiform, 120-190 μm high and 90-165 μm wide; pycnidial wall brown in the upper parts, colourless at the base, 20-22 μm. Conidia eseptate, 9-14 x 0.8-1 μm, curved.

Chemistry: Thallus K-, C-, KC-, P-. No substances detected by TLC.

Distribution and habitat: **Lecanactis olivascens** has been found twice on trees, in the mountain forest, at 2300-2800 m in the central mountains of Papua New Guinea.

Notes: **Lecanactis olivascens** is easily distinguished by its typically olivaceous apothecial discs. Closely related species with 5-septate spores (**L. platygraphoides** and **L. spermatospora** Egea & Torrente) never have such a colour. Moreover, there are slight but nevertheless significant differences in spores size: in **L. platygraphoides**, the spores measure 25-40(-45) x 3.5-5.5(-6) μm whereas in **L. spermatospora**, they are 40-56 x 4-5(-5.5) μm.

Additional specimen examined: Simbu prov., Mount Wilhelm area, Bundi Gap, on road Keglsugl-Bundi, 145°09'E 5°48'S, 2800 m, subalpine forest remnants, 8.1992, *H. Sipman* 35585 (B).

Lecanactis platygraphoides (Müll. Arg.) Zahlbr.

Madang prov., mouth of Boroi river near Bogia, E-side of island, 144°47'E 4°05'S, 1 m, mangrove forest, on *Rhizophora* , 7.1992, *A. Aptroot* 30451 (herb. Aptroot), *P. Diederich* 10723 (herb. Diederich) and *E. Sérusiaux* 13202 (LG). Madang prov., near Bogia, coastal forest E of Boroi river mouth, 144°48'E 4°06'S, 1 m, along the beach, epiphytic, 7.1992, *H. Sipman* (B). Madang prov., Huon Peninsula, Finisterre range, Yupna valley, Teptep village, 146°33'E 5°57'S, 2300-2650 m, disturbed mountain forest with scattered old trees, 7.1992, *P. Diederich* 10707, 10966, 10975 & 10978 (herb. Diederich), *E. Sérusiaux* 13601 (LG) and *H. Sipman* 35309 (B). Morobe prov., Gumi Divide, Head of Gumi Creek 35 km W of Bulolo 146°25'E 7°13'S, 1700 m, *Castanopsis* -Lauraceae dominated forest on side of ridge, crown of *Lithocarpus*, 10.1982, *H. Streimann* (CBG).

This species is known from the eastern coast of Australia and from Papua New Guinea. In the latter country, it is a rather rare epiphytic species, found from mangroves up to 2300-2650 m in mountain forest.
See Egea & Torrente (1994: 94) for a full description and photographs.

Lecanographa laingiana Diederich, Egea & Sipman

Madang prov., Laing Island in Hansa Bay, epiphytic in coastal forest on coral island, 7.1992, *H. Sipman* 34757 (B-holotype; UPNG-isotype), and *P. Diederich* 11652 (herb. Diederich). Madang prov., Krangket island near Madang, 145°49'E 5°12'S, coastal forest on coral island, on tree, 1 m, 8.1992, *A. Aptroot* 31858 (herb. Aptroot).

This species has just been described (Aptroot & al. 1995:32-34) from Laing Island, and has eventually been found in a further collection, also made in a coastal forest on a coral island near Madang.
See Aptroot & al. (1995:32-34 and fig. 2 d & d' and 6) for a full description and illustrations.

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NEW RECORDS OF THE GENUS *GYMNOPILUS* (AGARICALES, CORTINARIACEAE) FROM MEXICO

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SUMMARY

Five species of the genus *Gymnopilus* (Agaricales, Cortinariaceae) are recorded as new from Mexico. The species are: *G. subspectabilis* Hesler from subgenus *Annulati*; and *G. lepidotus* Hesler, *G. sapineus* (Fr.) R. Maire, *G. sordidostipes* Hesler and *G. subbellulus* Hesler from subgenus *Gymnopilus*. In addition, observations on *G. palmicola* Murrill are presented.

INTRODUCTION

Following the previous studies of the genus *Gymnopilus* made by the author (Guzmán-Dávalos & Guzmán, 1986, 1991; Guzmán-Dávalos, 1994, 1995), in the present paper five new records for Mexico are presented, including observations on *G. palmicola* Murrill.

Microscopic observations were made in 5% KOH and in Melzer's reagent; the later is used to detect the dextrinoid reaction. In all cases 20 spores were used as a minimum for the measurements, which include spores ornamentation. The length of basidia include sterigmata.

In particular cases where there are differences between the author's observations and descriptions of the types by Hesler (1969) short comments are given.

DESCRIPTIONS OR COMMENTS OF THE SPECIES

Gymnopilus lepidotus Hesler, *North Am. Sp. Gymnopilus*, p. 40, 1969. Figs. 1-18, 33-39 & 45-47

Pileus (3-)6-32(-70) mm diam., convex, campanulate-subumbonate, campanulate-truncated to plane-convex, surface fibrillose-squarrose or with erect, suberect or adpressed fibrillose scales, when young completely covered with fibrilles giving a lanose to squarrose appearance; dry, yellow, orange-yellow, orange-brown or ferruginous-brownish-yellow, scales vinaceous, vinaceous-red, vinaceous-brown or ferruginous-brown, margin even or shortly striate, thin. Lamellae adnate, subadnate, sinuate or subdecurrent, subclose to subdistant, broad to subventricose, margin pruinose to fimbriate, yellow, orange-yellow with or without mustard tinges, yellow-orange, cinnamon-brown or ferruginous-brown, staining ferruginous-brown or reddish, edge sometimes reddish-brown. Stipe (6-)9-30(-70) X 1-5(-7) mm, cylindric, uniform to subbulbous, central to excentric, fibrillose, longitudinally striate, with veil remmanents at apex, concolorous with the pileus or reddish-cream to whitish, occasionally staining red or dark reddish-brown when damaged, solid to hollow and filled with lax hyphae. Veil fibrillose, thick in young specimens but fugacious with age, whitish to yellow. Context whitish, yellowish or golden-yellowish, yellow or reddish-brown in the stipe; odour sweet fungous, taste fungous, bitterish at last in some cases. KOH stains pileus disk vinaceous, pileus edge dark brown, lamellae dark vinaceous-brown to almost black, stipe dark brown, pileus context reddish and stipe context golden-yellow. Spore print mustard-yellow with ferruginous tinges.

Spores 5.6-7.6(-8)(-8.8) X 4-4.8(-5.6)(-6) µm, ellipsoid to widely ellipsoid, few subglobose, with subthick wall, verrucose, without germ pore, yellowish-brown to orange-brown, dextrinoid (discoloring to yellowish or changing to brown with orange tinges, dark brown with reddish-pink tinges or dark orange-brown). Basidia 20-30.4(-38.4) X

(5.2-)5.6-8 µm, tetraspored, few monospored, sterigmata 0.8-5.6 µm long., clavate, with or without central constriction, hyaline or with yellow, orange, yellow-brown or orange-brown granulose or homogeneus content. Basidiola 18.4-33.6 X 6-8.4 µm, clavate to subspathulate, with orange or orange-brown homogeneus or granulose content, abundant. Pleurocystidia (17.6-)22.4-39.2(-45.6) X (4.8-)5.6-9.6(-12.5) µm, apex (1.6-)2.4-3.2 µm diam., ventricose-rostrate, subventricose-rostrate, subfusiform, occasionally lageniform, hyaline or with yellow, orange, orange-yellow or orange-brown irregular distributed granulose content, apex often without content, very abundant to rare. Edge heteromorphous, with basidia, basidiola and sometimes cells like pleurocystidia; with cheilocystidia 16-29.6(-34.4) X 5.2-8.4(-10) µm, apex 2.4-4.4(-5.6) µm, lageniform, non capitate, subcapitate or very few capitate, ventricose-rostrate or subfusiform, hyaline or with yellow, orange or orange-brown homogeneus or granulose content. Hymenophoral trama subparallel, hyphae with thin to subthick wall, hyaline or yellowish (in Guzmán 30296 some hyphae with orange-brown granulose pigment, adhered to internal walls, continuous or forming plaques). Pileus trama radial, hyphae with thin to subthick wall, hyaline to yellowish. Cuticle with hyphae 4-24 µm diam., postrate, or suberect to erect and grouped in fascicles when forming the scales, terminal elements rounded, uniform or slightly thinner at the apex, hyaline, yellowish or yellowish-brown, with yellowish-brown wall incrusted pigment (in MEXU-6965 also with citoplasmic granulose pigment, sometimes forming plaques inside the wall). Pileocystidia absent. Caulocystidia 20-64 X 4-12.8(-15.2) µm, eventually very long and difficult to size, cylindric, subclavate, clavate, subspathulate, spathulate, ventricose, very few with capitate apex, hyaline, solitary or in tufts, present in apex and medium part of the stipe, abundant to rare. Clamp connections present. With lactiferous hyphae, at times very abundant. A yellow pigment is disolved when mounted in KOH, except specimens Guzmán-Dávalos 5798, MEXU-6868 and MEXU-6965.

HABITAT. Solitary, gregarious to cespitose, on fallen trunks including *Inga jinicuil* Schl., in gardens from subtropical zones or in evergreen tropical forest.

MATERIAL STUDIED. MEXICO: STATE OF JALISCO, Municipality of Zapopan, Guadalajara University, Instituto de Botánica, July 24, 1991, **Guzmán-Dávalos 5301** (IBUG). STATE OF VERACRUZ, Municipality of Coatepec, old road Xalapa-Coatepec, Zoncuantla, June 6, 1991, **Guzmán 30296** (XAL, IBUG); Sept. 14, 1991, **Guzmán 30374** (XAL, IBUG); April 3, 1992, **Guzmán 30455** (XAL, IBUG); Nov. 11, 1992, **Guzmán 30602** (XAL, IBUG); April 5, 1993, **Guzmán-Dávalos 5798** (IBUG); Los Tuxtlas region, Station of Los Tuxtlas, May 23, 1969, **Herrera** (MEXU-6868); Laguna Encantada, May 23, 1969, **Martínez & Herrera** (MEXU-6965). U.S.A.: Florida, Natural Bridge, July 31, 1954, **Campbell 21453** (holoype, TENN).

OBSERVATIONS. *G. lepidotus* is characterized by the pileus with vinaceous-brown tiny scales, adpressed to erect on a light background; by the basidiola and pleurocystidia with orange granulose content, normally very abundant, the shape of pleurocystidia, the cheilocystidia non capitate to subcapitate, and the radial pileus trama. Hesler (1969) pointed out the pileus size of 4-8 mm diam.; however, the type measure 6-18(-26) mm (estimated from dry material). He also considered pleurocystidia as rare, but mentioned the presence of "flask-shaped" basidiola, with brown content, that I interpreted as pleurocystidia. Collection MEXU-6868 is a rather immature specimen which has smaller spores (5.6-6.4 µm long.) and does not present caulocystidia, but it has the typical pleurocystidia characteristic from this species. Basidiomata of MEXU-6965 are bigger than the rest of studied material (pileus up to 70 mm diam.). Macroscopically, *G. lepidotus* is related with *G. pacificus* Hesler, but the last one has pleurocystidia hyaline to yellowish, principally spathulate and the pileus trama interwoven (Hesler, 1969). According to Hesler, the spores of *G. pacificus* are 5.5-7(-7.5) X 4-5 µm, but a re-examination of the type specimen (Bessey 722, MICH) revealed spores of 7-10 X 4.5-6 µm; furthermore caulocystidia, considered by Hesler, were lacking.

Gymnopilus sapineus (Fr.) Maire, *Treballs Mus. Cien. Nat. Barcelona 15:* 96, 1933.
= *Agaricus sapineus* Fr., *Syst. Myc. 1:* 239, 1821.
= *Flammula sapinea* (Fr.) P. Kumm., *Der Führer in die Pilzk.*, p. 82, 1871.
= *Dryophila sapinea* (Fr.) Quél., *Enchir. Fung.*, p. 71, 1886.

= *Fulvidula sapinea* (Fr.) Romagn., *Rev. Mycol. II. 2:* 191, 1937. Figs. 19-24 & 40

Pileus 30-50 mm diam., campanulate-conic, convex-plane to plane, decurved margin, squarrose-fibrillose to squamulose, dry, golden-yellow, orange-yellow or brown-orange-yellow. Lamellae adnate, at times sinuate with a decurrent tooth, close, broad, cream-yellow, orange-yellow, finally ferruginous-brown, edge lightly fimbriate. Stipe 20-70 X 4-7 mm, more or less uniform, central, fibrillose, whitish to concolorous with the pileus, occasionally stained reddish-brown when bruishing, solid to hollow. Veil not observed (yellowish, scanty and fugacious sensu Hesler, 1969). Context yellow, odor pleasant, taste bitter. KOH stains pileus dark reddish-brown in dry material.

Spores 7.2-9.6(-10) X 4.8-6(-6.4) µm, ellipsoid, with subthick wall, verrucose, without germ pore, orange-yellow-brown, dextrinoid (dark orange-brown in Melzer's reagent). Basidia 23.2-32 X 5.6-8.8 µm, tetraspored, few bisporic, sterigmata 0.8-4 µm long., clavate, with or without central constriction, hyaline or with yellow or yellow-brown content. Pleurocystidia 18.4-27.2 X 4.4-8.8 µm, apex 3.2-5.6 µm diam., ventricose or lageniform, non capitate or subcapitate, some with a wall thickening apex, hyaline or with yellow or yellow-brown content, very rare. Cheilocystidia (16-) 20.8-40 X 4.8-8 µm, apex 3.2-7.2 µm diam., lageniform, cylindric-ventricose or cylindric, many laterally inflated, with long or short neck, capitate or subcapitate, very few non capitate, hyaline or with yellow or orange-yellow content. Hymenophoral trama subparallel, hyphae yellowish. Pileus trama radial, hyphae with thin to subthick. wall, yellowish. Cuticle with hyphae 4.4-11.2 µm diam., postrate, sometimes grouped in fascicles of suberect to erect hyphae or pileocystidia. Pileocystidia 36-44 X 6.8-8.8(-12.8) µm, clavate or ventricose-rostrate, walls with or without incrusted pigment. Caulocystidia 23.2-72.8 X 2.4-6.5(-9.2) µm, cylindric or filamentous, some laterally inflated, subcapitate to capitate, at times with a wall thickened apex, hyaline or with yellow or light yellow-brown content, present in stipe apex, in tufts. Clamp connections present. With lactiferous hyphae. A yellow pigment is disolved when mounted in KOH.

HABITAT. Solitary, gregarious to cespitose on trunks or rotting wood, in coniferous (U.S.A.) or *Pinus-Quercus* forests (Mexico).

MATERIAL STUDIED. MEXICO: STATE OF OAXACA, Municipality of San Juan Mixtepec, 14 km W from San Juan Mixtepec, Tejocotes, Sept. 4, 1989, **Guzmán-Dávalos 4977** (IBUG). U.S.A.: Idaho, Valley Co., Payette Lakes, June 28, 1958, **Smith 58394** (MICH); State of Washington, 1969, **Hatfield 3** (MICH).

OBSERVATIONS. This species is distinguished by the color and ornamentation of the pileus, cystidia presence and the radial pileus trama. The caulocystidia of the Mexican material are shorter and wider than those observed in the specimen Smith 58394, but both within species range. It is closely related to *G. penetrans*, but this has a glabrous pileus, spores verruculose, pileocystidia absent and generally a yellow pigment is not disolved when mounted in KOH. *G. sapineus* is a widely cited species in literature, and it is known from North America, South America, Europe, Africa, Asia and Australia (Cooke, 1884-1886; Bresadola & Saccardo, 1899; Kauffman, 1918; Bresadola, 1927; Maire, 1933; Konrad & Maublanc, 1948; Kühner & Romagnesi, 1953; Hesler, 1969; Gilbertson, 1974; Guzmán, 1977-B; Pegler, 1977; Moser, 1983; Natarajan & Raman, 1983; Lindsey, 1988; Singer, 1986; Bon, 1987; Höiland, 1990); however, until now it was unknown from Mexico.

Gymnopilus sordidostipes Hesler, *North Amer. Sp. Gymnopilus,* p. 38, 1969.
Figs. 25-32

Pileus 25-90 mm diam., convex, campanulate to plane, glabrous to fine fibrillose, subsquamose-fibrillose or with fibrillose scales, hygrophanous, orange-brown with disk and scales darker. Lamellae adnate to subdecurrent, some with a decurrent tooth, subclose, narrow to broad, yellow-brown to ferruginous-brown. Stipe 35-75 X 3-12 mm, uniform, subbulbous, central to excentric, sinuous, fibrillose, orange-brown, darker with age, hollow. Veil aracnoid, fugacious in semiadults and adult specimens. Context whitish to yellowish, odor pleasant or slightly acid, taste something bitter.

Spores 6-7.6(-8.5) X 4.4-4.8(-5.5) µm, ellipsoid, with subthick wall, verrucose, without germ pore, orange-brown in KOH, light yellow-brown in water and lactophenol, probably dextrinoid (yellowish or yellowish-brown in Melzer's reagent)(see observations). Basidia 16.8-25.6 X 4.8-6.4 µm (24-30 X 6-7.5 µm in type), tetraspored, sterigmata 2.4-4 µm long., clavate, with or without central constriction, hyaline or with yellowish or grayish yellow content. Pleurocystidia 19.2-25.6 X 4.8-7.6 µm, apex 3.6-5.2 µm diam., lageniform or ventricose, capitate or subcapitate, hyaline or with yellowish or orange-brown content, very abundant and conspicuous. Cheilocystidia 15.2-25.6 X 3.6-7.2 µm, apex 4-5.6 µm diam., ventricose, cylindric or lageniform, subcapitate or capitate, with yellowish, yellowish brown or orange-brown content. Hymenophoral trama subparalell, very thin, with hyphae hyaline or yellowish. Pileus trama radial. Cuticle with hyphae 4.8-13.6 µm diam., postrate, hyaline or yellowish, with yellowish brown wall incrusted pigment. Pileocystidia 44.8-67.6 X 9.6-13.6 µm, cylindric to clavate, erect to suberect, generally grouped, with subthick wall, with or without yellowish brown incrustations. Caulocystidia 33.6-49 X 5.5-9.2 µm, apex 5.6-7 µm diam., cylindric-clavate, ventricose, non capitate or capitate, yellowish, with or without yellowish brown wall incrusted pigment, present in stipe apex. Hyphae from stipe base 3.2-9.2 µm diam., with thick wall (0.8-2 µm), septate, some inflated at medium part and thinner to the septa, yellowish. Clamp connections present. With few lactiferous hyphae. A yellow pigment (type) or brown with reddish tinges (Guzmán-Dávalos 4235) is disolved when mounted in KOH.

HABITAT. Cespitose on burnt wood or sawdust, in coniferous (U.S.A.) or *Pinus-Quercus* (Mexico) forests.

MATERIAL STUDIED. MEXICO: STATE OF JALISCO, Municipality of Mazamitla, near to Mazamitla, July 21, 1988, **Guzmán-Dávalos 4235** (IBUG). U.S.A.: Oregon, Josephine Co., Grants Pass, Nov. 18, 1956, **Smith 55808** (holotype, MICH).

OBSERVATIONS. *G. sordidostipes* is defined by the basidioma size, the features of the pileus, the stipe darkening with age, as well as the presence of cystidia, and by the radial pileus trama. Hesler (1969) described the context concolor with the pileus, but in Mexican material is whitish to yellowish, and concolor only when dry. The spores from the type, and according to Hesler (*op. cit.*) are typically dextrinoid, changing to dark orange-brown in Melzer's reagent. However in Mexican material they discolored with the same reagent. On the other hand, Hesler recorded basidia 22-25 X 5-6 µm, pleurocystidia 23-27 X 5-6 µm and cheilocystidia 17-28 X 4-6 µm, but a study on the type specimen showed basidia 24-30 X 6-7.5 µm, pleurocystidia 18-25 X 5-7.5 µm and cheilocystidia 26-45(-71) X 4-9 µm. Furthermore, Hesler mentioned as an important characteristic of this species the presence of two types of pileocystidia; either in the type nor in studied material was observed differences in these structures.

Gymnopilus subbellulus Hesler, *North Amer. Sp. Gymnopilus,* p. 46, 1969.
Figs. 44 & 55-64

Pileus 10-20 mm diam., convex to plane, occasionally subumbonate, furfurescence or minutelly fibrillose-squamulose (velvety to slightly fibrillose when dry), dry, ochre-yellow, ochreous-tan or ferruginous-yellowish-brown, margin incurved. Lamellae adnate, subdistant or subclose, narrow to broad, lemon-yellow to cinnamon-brown or light mustard-orange-brown, edge even. Stipe 30-50 X 3-5(-7) mm, uniform or wider to the base, central to excentric, glabrous to fibrillose, chestnut-brown or ochreous, yellow in the apex, olivaceous-brown in the base. Veil absent. Context thin, yellowish to yellowish-brown, odour absent or mild, taste mild, not distinctive.

Spores 4.5-6.5 X 3.5-4.5 µm, widely ellipsoid to subglobose, with subthick wall, verrucose, without germ pore, orange-yellowish-brown, not dextrinoid. Basidia 21-33 X 5-6 µm, tetraspored, few bispored, sterigmata 1.5-6 µm long., clavate, with central constriction, hyaline to yellowish. Pleurocystidia 16-25 X 4-6(-10) µm, ventricose to lageniform, non capitate to subcapitate, few capitate, hyaline or yellowish, rare. Cheilocystidia 20-33 X 3-6 µm, apex 2-5 µm, tibiiform or lageniform, with long and thin neck, subcapitate to capitate, hyaline, or with yellowish to yellowish-brown content. Hymenophoral trama subparallel. Pileus trama radial. Cuticle with postrate hyphae, yellowish-brown or orange-yellowish-brown, with incrusted pigment in their walls. Pileocystidia of two types: a) 26-58 X (5-)10-17 µm, spathulate to clavate, hyaline or with yellowish-brown content, some with incrusted wall, and b) 32-49 X 5-6.5 µm, apex 4-5.5 µm diam., lageniform, with long neck, capitate, hyaline or with yellowish-brown content. Caulocystidia (16-)26-40 X (2-)4-6.5 µm, apex 2.5-4.5 µm, tibiiform, lageniform or few ventricose, with long and thin neck, capitate, with yellowish or yellowish-brown content, present only in stipe apex, in tufts or forming a palisade. Clamp connections present. A yellow pigment was disolved when specimen Singer M-1587 was mounted in KOH.

HABITAT. Solitary or gregarious on coniferous wood (*Abies* in the Mexican material), in coniferous forests.

MATERIAL STUDIED. MEXICO: STATE OF MEXICO, Volcán Popocatépetl, between San Pedro Nexapa and Paso de Cortés, July 21, 1957, **Singer M-1587** [MICH, as *G. microsporus* (Singer)Singer]. U.S.A.: Michigan, Luce-Chippewa Co., Tahquamenon Falls State Park, August 1, 1955, **Smith 49838** (holotype, MICH).

OBSERVATIONS. *G. subbellulus* is characterized because of its small, widely ellipsoid to subglobose spores, long necked, capitate cheilocystidia, the presence of pileocystidia and caulocystidia and its association to coniferous forests (Hesler, 1969; Horak, 1989). In the original description Hesler indicated two kinds of pleurocystidia, and rare caulocystidia. However, both the type and the Mexican material only have one kind of pleurocystidia and the caulocystidia are very common. On the other hand, in Mexican material we only could observe one kind of pileocystidia. Natarajan & Raman (1983) considered this species, with a different concept: pileus 40 mm diam., without pleurocystidia, smaller cheilocystidia and apparently without pileocystidia. *G. subbellulus* is distinguished from *G. bellulus* (Peck) Murrill mainly because the later one has dextrinoid and narrower spores, and a bitter taste. Hesler (*op. cit.*) mentioned a yellow bright color of the lamellae as a distinctive feature in *G. bellulus*, but this color is also present in the lamellae of *G. subbellulus*. The Mexican material was considered by Singer (1957) as *G.* aff. *bellulus*, but he identified it as *G. microsporus* on the herbarium label . The last species has a glabrous and hygrophanous pileus and the context with a bitter taste (Moser, 1983; Moreno & Esteve-Raventós, 1990); moreover Bresadola (1927) described and depicted the cystidia of this species (as *Flammula liquiritiae* sensu Bres. non Fr.) as fusoid-ventricose.

Gymnopilus subspectabilis Hesler, *North Amer. Sp. Gymnopilus*, p. 21, 1969.

Figs. 48-51 & 65

Pileus 45-135 mm diam., convex, convex-campanulate to truncate-campanulate, subvirgate, with irregular to radial fibrilles or fibrillose-squamulose, dry, brown-yellow or yellowish-brown with ferruginous tinges. Lamellae adnate, subclose to close, subnarrow to broad, ferruginous-brown. Stipe 35-225 X 8-45 mm, cylindric or subbulbous, central to excentric, striate-fibrillose, yellowish-white, solid. Annulus submembranous to membranous, apical, whitish to light yellowish. Context thick, light yellow, taste bitter. Context stains orange-brown with KOH and olive with $FeSO_4$ ("at gill line"), according to the fresh data from type material; pileus and stipe stain dark orange-brown with KOH when dry in Guzmán 24342.

Spores (8.4-)9.6-11.6(-12) X 5.2-6.8(-7.2) µm, subfusiform, sublimoniform or amygdaliform, with subthick wall, verrucose, with large warts, without germ pore, orange-yellow or yellowish-brown, dextrinoid (spores from Guzmán 24342 without change in Melzer's reagent). Basidia 27.2-37 X 6-8 µm, tetraspored, few bispored, sterigmata 0.8-5.2 µm long., clavate to cylindric-clavate, with or without central constriction, hyaline or with homogenous to granulose content, yellowish, yellow or orange-yellow. Pleurocystidia 24-33.6 X 5.2-7.6 µm, clavate-subcapitate to subfusiform, hyaline or with granulose, yellowish, refringent content, very rare and inconspicuous. Cheilocystidia 24-37.6(-44.8) X 4.4-7.2 µm, apex 2.4-5.2(-7) µm diam., cylindric-ventricose, cylindric or lageniform, capitate, subcapitate or non capitate, hyaline or with homogenous to granulose content, yellowish or yellowish-brown, edge heteromorphous, fertile. Hymenophoral trama subparallel. Pileus trama interwoven. Cuticle with hyphae 3.2-8 µm, postrate, with homogenous to granulose content, yellowish or brown-yellowish. Pileocystidia absent. Caulocystidia 27-49 X 8-13 µm, apex 5-8 µm, ventricose or lageniform, capitate, yellowish, present in stipe apex, very common (see observations). Clamp connections present. With lactiferous hyphae. A yellow pigment is disolved in KOH.

HABITAT. Gregarious to cespitose on *Pinus* trunk, in *Pinus* with *Salix* and *Quercus* forest (Mexico), or on hardwood in deciduos forests (U.S.A.).

MATERIAL STUDIED. MEXICO: BAJA CALIFORNIA NORTE, Sierra de Juárez, near Laguna Hanson, 3 km SE from Rancho Aserradero Viejo, March 2, 1984, **Guzmán 24342** (IBUG, XAL). U.S.A.: Michigan, Washtenaw Co., Ann Arbor, Oct. 25, 1961, **Smith 64755** (holotype, MICH).

OBSERVATIONS. This species is closely related to *G. spectabilis* (Fr.) A. H. Sm., in the basidioma appearance as in microscopic characteristics; the main difference is the form and size of the spores which are ellipsoid and smaller in *G. spectabilis* (Hesler, 1969; Ammirati *et al.*, 1985). From *G. rugulosus* R. Valenz., Guzmán & J. Castillo, it is distinguished by the basidioma color, and by the subglobose to widely ellipsoid, tuberculate and smaller spores (Valenzuela *et al.*, 1981). *G. subspectabilis* was only known from the U.S.A. In Mexican material true caulocystidia were not observed, only hyphae with rounded or occasionally subcapitate apex occur.

Gymnopilus palmicola Murrill, *Mycologia 5:* 23, 1913.
= *Flammula palmicola* (Murrill) Murrill, *Mycologia 5:* 36, 1913.
Figs. 41-43 & 66-68

It is charactherized by its scaly pileus, the veil forming an annular zone, large spores [8-11.6(-12) µm long] with conspicuous warts and by the interwoven pileus trama. Hesler (1969) also mentioned as an important feature, the presence of pleurocystidia, not seen in the studied material including the type. On the other hand, Hesler (**op. cit.**) considered the species without caulocystidia, and these were seen in the type but not in the Mexican material. Hesler (**op. cit.**) recorded this species from Mexico, based on a material of Singer, that grew on an orchid from the State of Oaxaca.

Singer (1951) considered *G. aculeatus* (Bres. & Roum.)Singer to be from Mexico and U.S.A, based on his material from an orchid from

Oaxaca [see photograph in Singer (1986) as *G. aculeatus*] and on the specimen Singer F-545 from Florida. Singer regarded this species to have very broad limits in the size of the spores, from 6.8 to 11 µm long., "rather variable in size and shape from collection to collection (from as short as 9 X 7 µ to as elongate as 11 X 6.8 µ, mostly around 8-9.5 µ or less when quite mature and more often relatively short than relatively long)" (Singer, 1951). In the original description of *G. aculeatus* (as *Pholiota aculeata* Bres. & Roum.) from Africa, Bresadola & Roumeguère (1890) described spores of 6-7 X 4-4.5 µm. The studied Mexican material has spores longer [8-11.6(-12) X 5.6-7.2(-7.6) µm], these agree with the spores of *G. palmicola*. Also the studied specimen from Florida has longer spores. So we can conclude that *G. aculeatus* is unknown from America.

HABITAT. Gregarious on trunks of palms or on a living orchid in a greenhouse.

MATERIAL STUDIED. U.S.A.: Massachusetts, Crambidge, greenhouse, on an orchid from Mexico (State of Oaxaca), Oct. 25, 1946, **Singer** (FH, as *G. aculeatus*). Florida, Highlands Co., Highlands Hammock State Park, near Sebring, Sept. 4, 1942, **Singer F-545** (FH, as *G. aculeatus*). CUBA: near Baracoa, El Yunque, March, 1903, **Underwood & Earle 1134** (holotype of *G. palmicola*, NY).

ACKNOWLEDGEMENTS

Thanks are due to G. Guzmán and V. M. Bandala, both from Instituto de Ecología at Xalapa, Ver., Mexico for the critical review of this paper. The Curators from FH, MEXU, MICH, NY, TENN & XAL, kindly lent important specimens, especially types. M. R. Vázquez from the University of Guadalajara, Mexico assisted with the drawings. M. Harker also from University of Guadalajara and E. Kakudidi from Makeree University, Uganda improved the English text.

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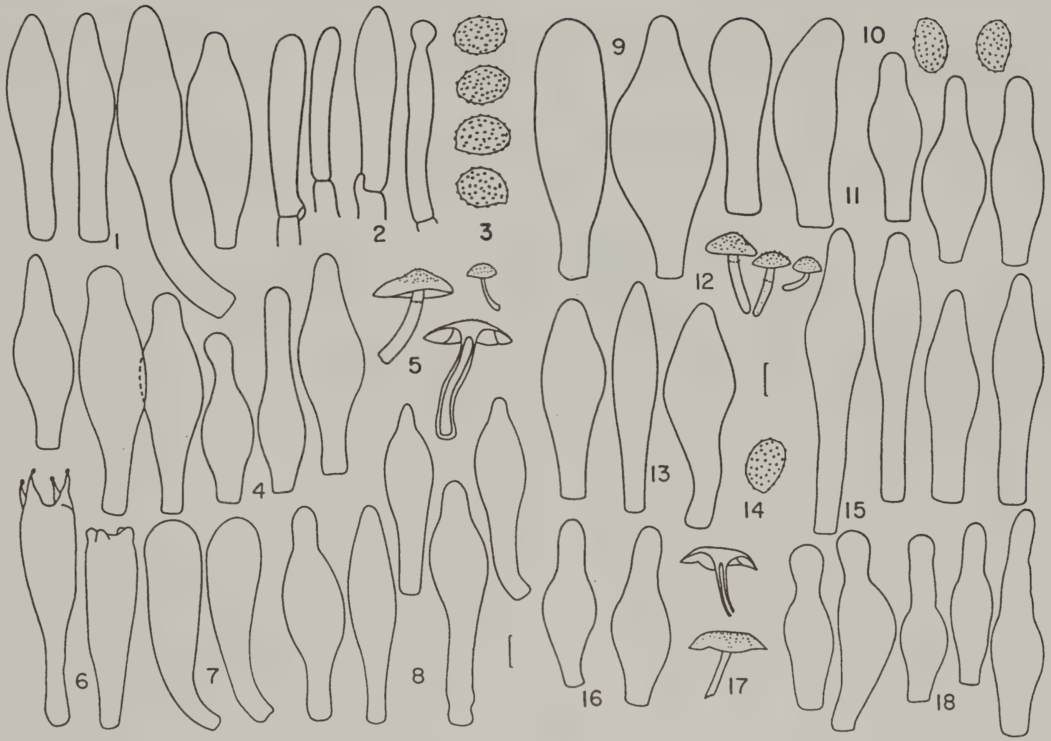
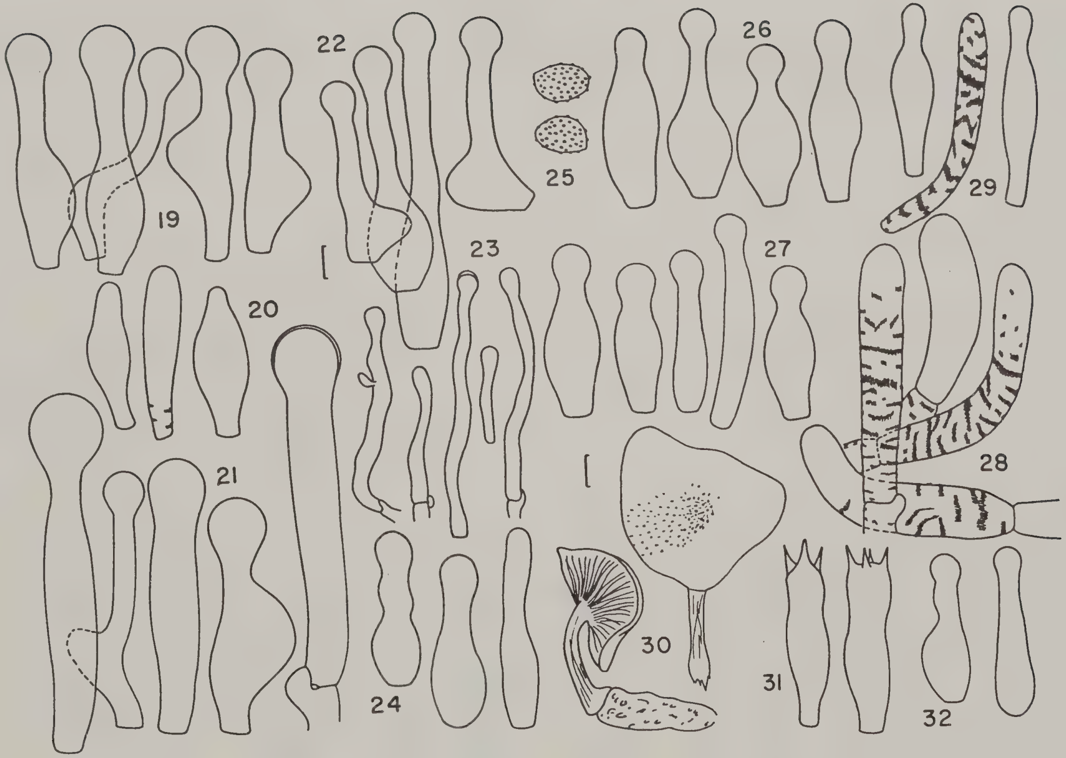
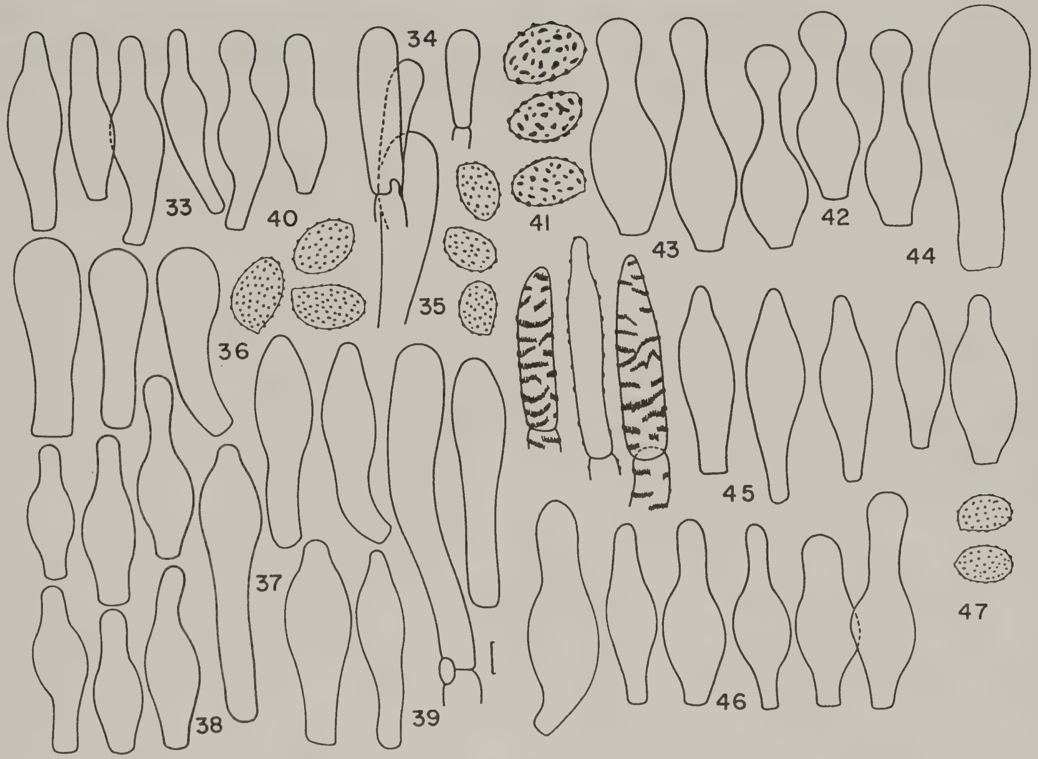


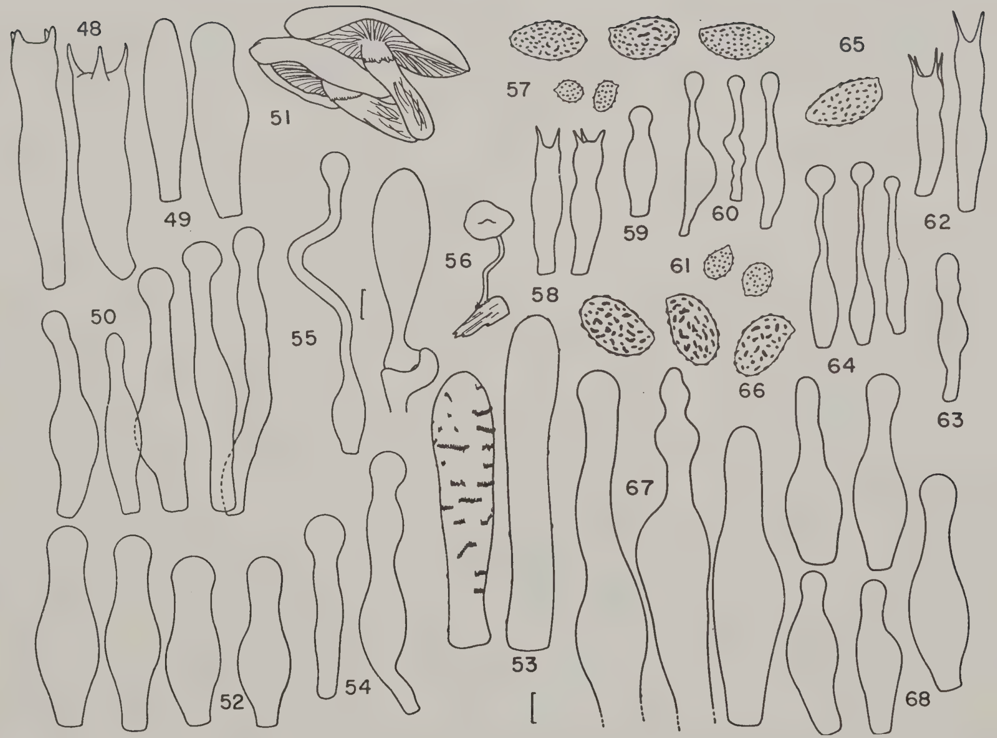
Figs. 1-18. ***Gymnopilus lepidotus,*** 1: pleurocystidia, 2: caulocystidia, 3: spores, 4: cheilocystidia, 5: basidiomata, 6: basidia, 7: basidiola, 8: pleurocystidia, 9: caulocystidia, 10: spores, 11: cheilocystidia, 12: basidiomata, 13: pleurocystidia, 14: spore, 15: pleurocystidia, 16: cheilocystidia, 17: basidiomata, 18: cheilocystidia, (1, 2, 4: Guzmán-Dávalos 5301; 5-8 Guzmán 30374; 9: Martínez & Herrera; 10, 11, 13: Herrera; 12, 14: Guzmán-Dávalos 5301; 15-16: Guzmán-Dávalos 5798; 17-18: Guzmán 30602) Scale = 4 µm, except 2 = 8 µm; 5, 12, & 17 = 10 µm



Figs. 19-32. 19-24: ***Gymnopilus sapineus,*** 19: cheilocystidia, 20: pileocystidia, 21: caulocystidia, 22: cheilocystidia, 23: caulocystidia, 24: pleurocystida 25-32: ***Gymnopilus sordidostipes,*** 25: spores, 26: pleurocystidia, 27: cheilocystida, 28: pileocystidia, 29: caulocystidia, 30: basidiomata, 31: basidia, 32: pleurocystidia (19-21: Guzmán-Dávalos 4977; 22-24: Smith 58394; 25-29: Guzmán-Dávalos 4235; 30-32: holotype) Scale = 4 µm, except 20 & 23, 28-29 = 8 µm; 30 = 15 µm; 31-32 = 5 µm



Figs. 33-47. 33-39: ***Gymnopilus lepidotus***, 33: cheilocystidia, 34: caulocystidia, 35: spores, 36: basidiola, 37: pleurocystidia, 38: cheilocystidia, 39: caulocystidia. 40: ***G. sapineus,*** spores. 41-43: ***G. palmicola***, 41: spores, 42: cheilocystidia, 43: pileocystidia. 44: ***G. subbellulus,*** pileocystidium, 45-47: ***G. lepidotus***, 45: pleurocystidia, 46: cheilocystidia, 47: spores (33-34: Guzmán 30374; 35-39: holotype; 40: Guzmán-Dávalos 4977; 41-43: Singer; 44: Singer M-1587; 45-47: Martinez & Herrera) Scale = 33, 35-42, 45-47 = 4 µm; 34 & 43 = 8 µm; 44 = 5 µm



Figs. 48-68. 48-51: ***Gymnopilus subspectabilis***, 48: basidia, 49: pleurocystidia, 50: cheilocystidia, 51: basidiomata, 52-53: ***G. sapineus,*** 52: pleurocystidia, 53: pileocystidia. 54: ***G. sordidostipes***, cheilocystidia. 55-64: ***G. subbellulus***, 55: pleiocystidia, 56: basidioma, 57: spores, 58: basidia, 59: pleurocystidium, 60: cheilocystida, 61: spores, 62: basidia, 63: pleurocystidium, 64: cheilocystidium, 65: ***G. subspectabilis***, spores. 66-68: ***G. palmicola,*** 66: spores, 67: caulocystidia, 68: cheilocystidia (48-50: Guzmán 24342; 51: holotype, 52: Guzmán-Dávalos 4977; 53: Smith 58394; 54: holotype; 55, 61-64: holotype; 56-60: Singer M-1587; 65: Guzmán 24342; 66-68: holotype) Scale = 4 µm, except 51 = 10 mm; 55, 57-64 = 5 µm; 56 = 15 µm

MYCOTAXON

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FUNGI ON *JUNCUS ROEMERIANUS.*
7. TIAROSPORELLA HALMYRA SP. NOV.

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ABSTRACT

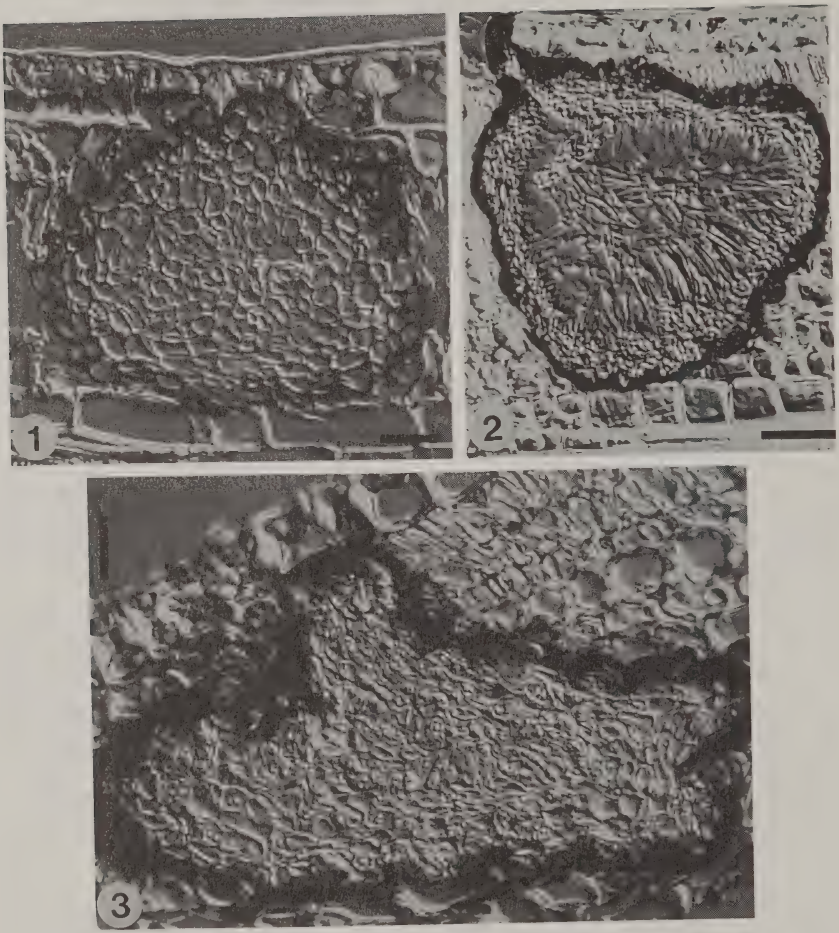
Tiarosporella halmyra sp. nov. is the first coelomycete described from the saltmarsh plant *Juncus roemerianus*. It occurs infrequently in the lower and middle part of standing dead culms and is known so far from North Carolina and Virginia. The new species is considered to be a facultative marine fungus. It is compared with *T. paludosa.*

INTRODUCTION

A survey of fungi on dead standing culms of *Juncus roemerianus* Scheele, an endemic saltmarsh plant of the eastern United States, has resulted in the description of a number of new ascomycetes (see for instance Kohlmeyer *et al.* 1995b,c) and a hyphomycete (Kohlmeyer & Volkmann-Kohlmeyer 1995). The first coelomycete to be known from this host is described in the following. Methods and abbreviations of collecting sites have been published by Kohlmeyer *et al.* (1995a).

Tiarosporella halmyra Kohlm. & Volkm.-Kohlm., anam.-sp. nov.
Etymology: From the Greek *ἁλμυρός* = salty, sea-, in reference to the habitat.

Conidiomata *120-225 (-320) µm alta, 150-370 (-440) µm diam., pycnidioidea, ellipsoidea, obpyriformia vel irregularia, unilocularia, omnino immersa in cortice, ostiolata, papillata, atrobrunnea, singularia;* papilla *36-47 µm alta, 22-34 µm diametro, cylindrica ad conica, saepe excentrica, sparsim periphysata;* peridium *19-30 µm crassum, 4-7 stratis cellularum multangularium, leptodermarum; stratum externum atrobrunneum, strata interna hyalina, texturam angularem formans;* conidiophora *ad cellulas*



FIGS. 1-3. *Tiarosporella halmyra*. 1. Conidioma initial, 4 μm longitudinal section, embedded in host tissue; center filled with thin-walled pseudoparenchyma. 2. Mature conidioma, 12 μm longitudinal section, papilla on left side. 3. Immature conidioma, 10 μm longitudinal section, conidiogenous cells starting to develop. FIGS. 1-3 from Herb. J.K. 5502. Scale bars: FIGS. 1,3, 20 μm; FIG. 2, 50 μm.

conidiogenas reducta, 5.5-9.5 x 2-3 μm, cylindrica vel elongate conica, circum cavitatem conidiomatis orientia; conidia *39 x 49 x 6.5-8.5 μm ($\bar{x}$ = 43.3 x 7.3 μm; n = 136), cylindrica, apice baseque rotundata, unicellularia, hyalina, laevia, 3-4 appendicibus apicalibus;* appendices *25-30 μm longae, tentaculiformes, undulatae, gelatinosae, e pileo apicale evolutae, ad apicem gradatim angustatae, sine vagina inter appendices; ratione conidii long./lat. = 6:1.*

SUBSTRATUM: *Culmi senescenti Junci roemeriani.*
DISTRIBUTIO: *Littus Oceani Atlantici, America Septentrionalis, (USA: North Carolina, Virginia).*
HOLOTYPUS: J.K. 5502 (**IMS**); ISOTYPUS: J.K. 5502 (**NY**).

Conidiomata 120-225 (-320) μm high, 150-370 (-440) μm diam., pycnidioid, ellipsoidal, obpyriform or with irregular shapes (Figs. 2,3), often bulging into cracks or open cell lumina of the host, unilocular, completely immersed in the cortical tissue, ostiolate, papillate, dark brown, single. **Papilla** 36-47 μm high, 22-34 μm in diam., cylindrical to conical, slightly raised above the epidermis, often not in the center but at one end of the conidioma (Fig. 2); ostiolar canal initially filled with a small thin-walled pseudoparenchyma, developing into short ellipsoidal periphyses. **Peridium** 19-30 μm thick, composed of 4-7 layers of polygonal thin-walled cells; the outer cell layer is dark brown, the inner layers are hyaline, forming a *textura angularis* in longitudinal section (Fig. 4). **Conidiophores** reduced to conidiogenous cells, 5.5-9.5 x 2-3 μm, cylindrical to elongate conical, lining the wall of the cavity (Figs. 4,5). **Conidia** 39-49 x 6.5-8.5 μm ($\bar{x}$ = 43.3 x 7.3 μm; n = 136), cylindrical with rounded apex and base, one-celled, hyaline, smooth, with 3-4 apical appendages (Fig. 6). **Appendages** 25-30 μm long, tentaculiform, undulate, gelatinous, tapering to a thin tip, without a sheath between the extended appendages (Fig. 6); originating from eversion and longitudinal split of a gelatinous sheath which covers the upper half of the immature conidium (Figs. 4,6); mean conidium length to width ratio = 6:1.

SUBSTRATUM: Senescent culms of *J. roemerianus.*
DISTRIBUTION: Atlantic Coast (U.S.A.: North Carolina, Virginia).

MATERIAL EXAMINED: Dead standing culms of *J. roemerianus*, NC-HI: 8 March 1993, J.K. 5502 (Holotype: **IMS**; Isotype: **NY**); NC-BC: 12 Oct. 1975 (J.K. 3681), 1 April 1977 (J.K. 3840), 7 Nov. 1977 (J.K. 3852), 1 Jan. 1995 (J.K. 5547); NC-SC: 27 Sept. 1994 (J.K. 5542); Virginia-Brownsville (37°27'N, 75°49'W): 20 Jan. 1995 (leg. R. Christian; J.K. 5550, also pure culture).

Tiarosporella halmyra resembles *T. paludosa* (Sacc. & Fiori) Höhn., a species characterized and illustrated in detail by Nag Raj (1993). *Tiarosporella paludosa* has more cell layers in the peridium (7-9), but the main difference is in the conidia which are narrowly truncate at the base (versus broader and rounded at the base in *T. halmyra*) and have smaller conidia (22-45 x 4-7 μm, versus 39-49 x 6.5-8.5 μm) with smaller means (33.5 x 5.5 μm, versus 43.3 x 7.3 μm). We have compared herbarium material of *T. paludosa* from Herb. DAOM (Nos. 90621, 196580, 215285, 215582) with *T. halmyra* and are confident that these are different species.

Conidiomata of *T. halmyra* were found at the lower and middle parts of the culms, from 7 to 63 cm above the rhizome and, therefore, the new fungus is considered to be a facultative marine species. Conidia placed in distilled water under a cover glass germinated at both apices within half an hour. Pure cultures on glucose/peptone/yeast seawater agar formed mature condiomata after 2 weeks. The new species was found only seven times in monthly collections over a two-year period and appears not to have a seasonality.

ACKNOWLEDGMENTS

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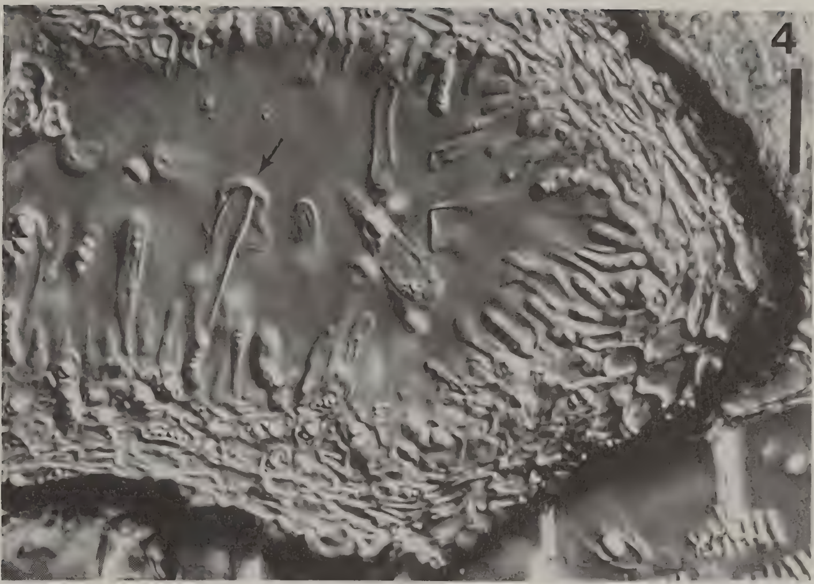
FIGS. 4-6. *Tiarosporella halmyra.* 4. Mature conidioma, partial view, 12 μm longitudinal section, most conidia immature, one (arrow) with unfolding appendages. 5. Conidia in different stages of development, squash mount. 6. Conidia with tentaculiform appendages, one with appendages not yet unfolded. FIGS. 4-6 from Herb. J.K. 5502. Scale bars: FIGS. 4-6, 20 μm.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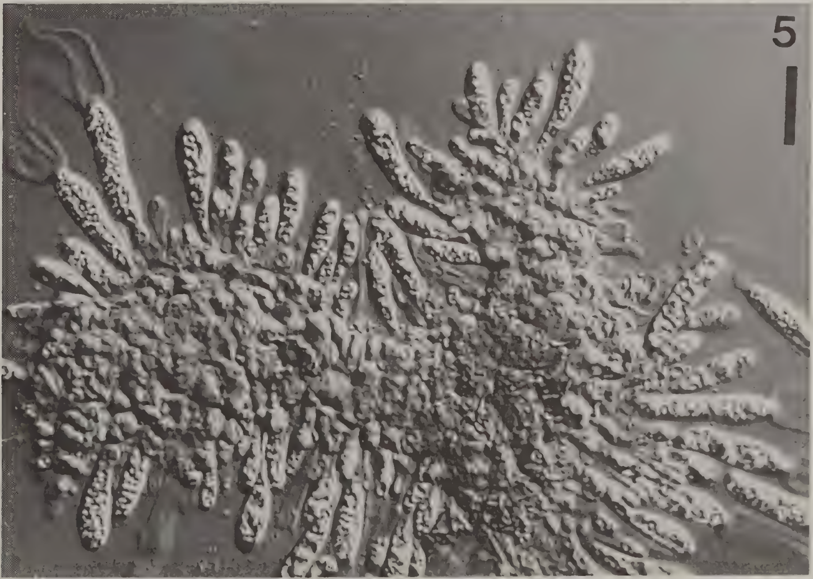
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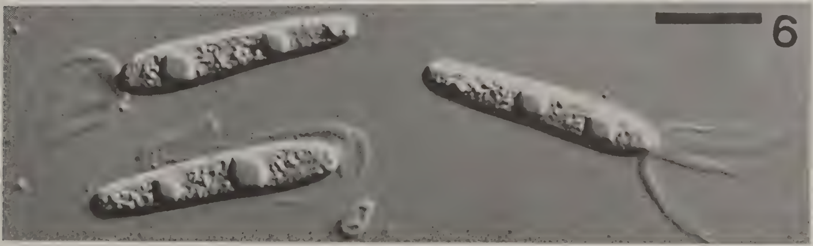
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MYCOTAXON

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TRANSFER OF *HANSENULA OFUNAENSIS* TO THE GENUS *PICHIA*

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Abstract

Hansenula represents a synonym of the genus *Pichia*, and because of this, *Hansenula ofunaensis* is transferred to *Pichia*. An emended physiological characterization of this yeast species is provided.

KEYWORDS: *Hansenula, Pichia, Pichia ofunaensis* (Makiguchi & Asai) Kurtzman comb. nov.

As was proposed by Stelling-Dekker in 1931, the major ascomycetous yeast genera *Hansenula* H. & P. Sydow and *Pichia* Hansen were separated from each other primarily on the basis of ability to assimilate nitrate as a sole source of nitrogen. *Hansenula* species utilize nitrate whereas *Pichia* species do not. Kurtzman (1984a) observed that *Hansenula minuta* Wickerham and *Pichia lindneri* Henniger & Windisch were phenotypically similar and demonstrated from comparisons of nuclear DNA (nDNA) complementarity that the two taxa showed 75% nDNA relatedness and could be considered conspecific. This comparison showed that nitrate assimilation was not a reliable criterion for separation of either species or genera and prompted the transfer of species of *Hansenula* with hat-shaped (galeate) ascospores to *Pichia*, the genus of taxonomic priority (Kurtzman, 1984a).

Cultures of four species of *Hansenula* were not available for study when the preceding transfer of species to *Pichia* was made. These species are *Hansenula arabitolgenes* Fang (an apparent nomen nudum cited by Chang et al., 1963), *H. misumaiensis* Sasaki & Yoshida (reported by Sasaki and Yoshida, 1958, but apparently never validly described), *H. ofunaensis* Makiguchi & Asai (Asai et al., 1976), and *H. ukrainica* Kvasnikov, Nagornaya & Shchelokova (Kvasnikov et al., 1979). Kurtzman (1992) found 97% nDNA relatedness between *H. ukrainica* and *Pichia anomala* (Hansen) Kurtzman demonstrating the former taxon to be a synonym of the latter.

A comparison of 5'-end nucleotide sequences of large subunit (26S) ribosomal RNAs (rRNA) from all known species of *Pichia* showed *P. subpelliculosa* Kurtzman and *H. arabitolgenes* to have identical sequences, thus indicating that *H. arabitolgenes* is a synonym of *P. subpelliculosa* (C. P. Kurtzman and C. J. Robnett, manuscript in preparation). Attempts to induce ascosporulation in cultures of *H. misumaiensis* have been unsuccessful (C. P. Kurtzman, unpublished; Barnett et al., 1990), and the taxonomic placement of this species is uncertain. In contrast, *H. ofunaensis* forms 1-4 hat-shaped ascospores (illustrated by Barnett et al., 1990), and the rRNA comparisons cited above show it to be distinct from other species of *Pichia*. *Pichia* is a large genus (91 species) that appears phylogenetically divergent (Billon-Grand, 1989; Kurtzman, 1984b; Yamada et al., 1994). However extensive molecular studies are needed before *Pichia* can be resolved along phylogenetic lines. Whether *H. ofunaensis* will remain in *Pichia* following this work is uncertain, but because *Hansenula* is no longer a valid genus, transfer of *H. ofunaensis* to *Pichia* will legitimize the taxonomic standing of this biologically unique species.

Pichia ofunaensis (Makiguchi & Asai) Kurtzman comb. nov. Basionym: *Hansenula ofunaensis* Makiguchi & Asai. *J. Gen. Appl. Microbiol.* **22**:200. 1976.

Physiological reactions determined in the present study differ somewhat from those reported by Asai et al. (1976) (Table 1). However, present results are in generally good agreement with those of Barnett et al. (1990).

Table 1. Fermentation and assimilation reactions of *Pichia ofunaensis*.[1,2,3,4]

Fermentation:

Glucose	ws	Lactose	-
Galactose	ws [-]	Raffinose	-
Sucrose	-	Trehalose	ws[-]
Maltose	-		

Assimilation:

Glucose	+	*N*-Acetyl-D-glucosamine	+[n]
Galactose	+ [-]	Methanol	- [+]
L-Sorbose	+	Ethanol	+
Sucrose	v [-]	Glycerol	+
Maltose	v [-]	Erythritol	v [+]
Cellobiose	s	Ribitol	+
Trehalose	+ [-]	Galactitol	+[-]
Lactose	+ [-]	D-Mannitol	+
Melibiose	+ [-]	D-Glucitol	+
Raffinose	v [-]	α-Methyl-D-glucoside	v [-]
Melezitose	v [-]	Salicin	s
Inulin	-	Gluconate	s [-]
Soluble starch	-	DL-Lactate	s [-]
D-Xylose	+	Succinate	+[-]
L-Arabinose	+ [n]	Citrate	s [n]
D-Arabinose	- [+]	Inositol	s [-]
D-Ribose	s	Hexadecane	- [n]
L-Rhamnose	+	Nitrate	+
D-Glucosamine	+ [n]	Vitamin-free	- [+]

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[1] Methods are those of Wickerham (1951).

[2] Symbols: + = positive, - = negative, v= variable upon replication, ws = weak and slow, s = positive but slow.

[3] Reactions in brackets are those from Asai et al. (1976) that differ from results of the present study; [n] = not tested by Asai et al.

[4] Results are from the type strain, the only known isolate, to which is assigned the following culture collection accession numbers: KM-1359 (Asai et al., 1976), CBS 6861, CBS 8129, NRRL Y-10998.

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TAXONOMICAL STUDIES ON USTILAGINALES. XIV. *

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ABSTRACT

The following groups of Ustilaginales were studied: *Entyloma* on *Eleocharis*; *Thecaphora* on Compositae; smut fungi on *Andropogon bicornis, Dactyloctenium, Iseilema, Stenotaphrum,* and some other smuts.

NEW SPECIES proposed: *Burrillia sagittariae* K. & C. Vánky (type on *Sagittaria planitiana*); *Thecaphora ambrosiae* K. Vánky (type on *Ambrosia artemisioides*); *Thecaphora polymniae* K. Vánky & Pardo-Cardona (type on *Polymnia riparia*); *Thecaphora spilanthes* Freire & K. Vánky (type on *Spilanthes oleracea*); *Ustilago ctenioides* K. Vánky (type on *Dactyloctenium ctenioides*).

NEW NAME proposed: *Sporisorium thirumalacharii* K. Vánky, replacing *Sorosporium iseilematis* Thirumalachar (not *Sporisorium iseilematis* (H. & P. Sydow & Butler) K. Vánky; type on *Iseilema laxum*).

NEW COMBINATIONS proposed: *Sporisorium bicornis* (P. Henn.) K. Vánky, based on *Ustilago bicornis* (type on *Andropogon bicornis*); *Sporisorium henningsii* (Sacc. & P. Sydow) K. Vánky, based on *Ustilago henningsii* (type on *Stenotaphrum glabrum*); *Sporisorium inayati* (H. & P. Sydow & Butler) K. Vánky, based on *Ustilago inayati* (type on *Iseilema laxum*); *Sporisorium iseilematis* (H. & P. Sydow & Butler) K. Vánky, based on *Ustilago iseilematis* (type on *Iseilema laxum*); *Sporisorium mitchellii* (H. & P. Sydow) K. Vánky, based on *Ustilago mitchellii* (type on *Iseilema mitchellii*); *Sporisorium manilense* (H. & P. Sydow) K. Vánky, based on *Ustilago manilensis* (type on *Sacciolepis indica*).

SYNONYMS: *Entyloma eleocharidis* M. S. Pavgi & R. A. Singh is both a synonym and homonym of *E. eleocharidis* (Sawada) Ling; *Sphacelotheca apludae-aristatae* Rao & Nema is a synonym of *Sporisorium*

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iseilematis (H. & P. Syd. & Butler) K. Vánky; *Sphacelotheca mauritanica* Zundel is a synonym of *Ustilago bouriquetii* Maublanc & Roger; *U. affinis* Ellis & Ev. var. *hilariae* (P. Henn.) G. W. Fischer & Hirschh., based on *Ustilago hilariae* P. Henn., 1898 (not Ellis & Tracy, 1890) is a synonym of *Ustilago hilariicola* G. W. Fischer; *Sphacelotheca sacciolepidis* Thirum. is a synonym of *Sporisorium manilense* (H. & P. Sydow) K. Vánky.

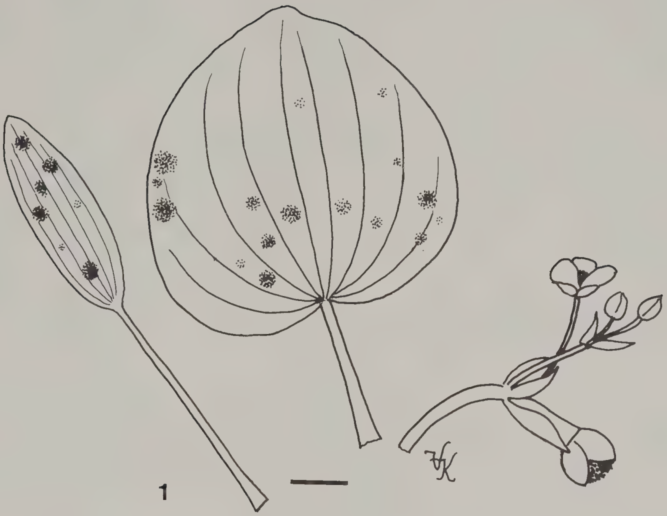
A new *Burrillia* of *Sagittaria.*

Recently, an unknown smut fungus belonging to the genus *Burrillia* was collected in Venezuela forming spore balls in the leaves of *Sagittaria planitiana* Agostini. No monographic work has been done on the spore-ball-forming smuts of the *Sagittaria* species. At least thirteen names have been published. Of these, about nine species can be recognised: one *Burrillia* (*B. pustulata* Setchell), one *Pseudodoassansia* (*P. obscura* (Setchell) K. Vánky), three *Doassansia*e (*D. disticha* S. Ito, *D. opaca* Setchell, *D. sagittariae* (Fuckel) C. Fisch), and four *Doassansiopsis* species (*D. deformans* (Setchell) Dietel, *D. furva* (Davis) K. Vánky, *D. horiana* (Hennings) Shen, and *D. intermedia* (Setchell) K. Vánky). Of these names some may be synonyms. Our fungus differs from all these species and it is described as:

Burrillia sagittariae K. & C. Vánky, **sp. nov.**

Typus in matrice *Sagittaria planitiana* Agostini (Alismataceae), Venezuela, Estado Guarico, 70 km N. urbe San Fernando, 8°28' N, 67°35' W, alt. ca. 100 m, 7.XII.1993, leg. R. Berndt, C. & K. Vánky. Holotypus in Herbario Ustil. Vánky (HUV 16004!), isotypi in BPI and in Vánky, Ust. exs. (ineditus).

Sori (Fig. 1) in foliis, quasi maculae primo flavidae, deinde pallide brunneae, circulares usque ellipsoidales, 1–5 mm magnae, in illis glomeruli sporarum in textum matricale immissi, sicut puncta minuta, brunnea, parum prominentia apparentes. Glomeruli sporarum (Fig. 3) forma magnitudineque variabiles, subglobosi, ovoidei usque subpolyedrice irregulares, 80–190 x 100–210 µm, flavidobrunnei, e sporis multis, per cellulas steriles, irregulares, vacuas, pariete tenui tunicatas plus-minus isolatis compositi. Glomeruli sporarum cortice (Fig. 4) e strato plus-minus continuo cellularum fungalium vacuarum relative crasse tunicatarum partim cellulis mycelialibus parvis, in strato unico vel in stratis nonnullis distributis forte inter cellulas matricales sicut fasciculi sese ostendentibus circumdati. Sporae (Figg. 4, 5) subglobosae, ovoideae, ellipsoideae vel parum irregulares, 9–13 x 10–15(–16) µm, pallide flavobrunneae, materiam homogeneam continentes; pariete levi, tenui (cca. 0,5 µm), uniformi. Sporae glomerulorum sporarum collisorum quasi irregulariter reticulatae apparentes propter partes residuas murorum tenuim fragiliumque cellularum sterilium. Cellulae steriles inter sporas irregulares, polyedricae, 2,5–8 µm longae, vacuae, muris tenuibus (cca. 0,2 µm), eo modo coloratae sicut sporae. Cellulae corticales (Figg. 4, 6) forma et magnitudine variabiles, irregulares, polyedricae, visu superficiali 4–13,5 x 5–20(–22) µm, parum obscuriores quam sporae; pariete 0,5–1,5 µm crasso, levi.



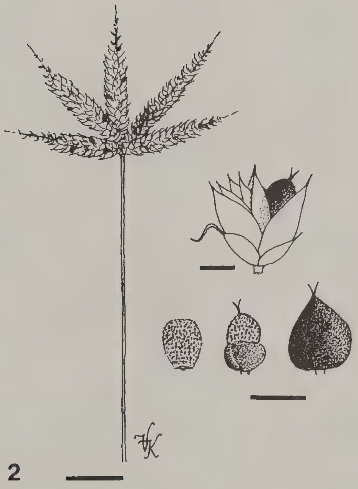


Fig. 1. Sori of *Burrillia sagittariae* K. & C. Vánky on the leaves of *Sagittaria planitiana* Agostini (type). Bar = 1 cm.

Fig. 2. *Ustilago ctenioides* K. Vánky on *Dactyloctenium ctenioides* (Steud.) Bosser. Habit and enlarged a spikelet with a sorus, a healthy seed, a partly infected seed and a seed completely transformed into sorus (type). Bars = 1 cm and 1 mm.

Sori (Fig. 1) in leaves forming first yellow later light brown, rounded to ellipsoidal, 1–5 mm large spots in which the spore balls, embedded in the host tissue, are seen as minute, brown, slightly elevated dots. Spore balls (Fig. 3) variable in shape and size, subglobose, ovoid to subpolyhedrally irregular, 80–190 x 100–210 µm, yellowish-brown, composed of numerous spores more or less isolated by irregular, empty, thin-walled sterile cells. Spore balls provided with a cortex (Fig. 4) composed of a more or less continuous layer of empty, relatively thick-walled fungal cells partly surrounded by small, mycelial cells arranged in one or several layers which may extend between the host cells as fascicles. Spores (Figs. 4, 5) subglobose, ovoid, ellipsoidal or slightly irregular, 9–13 x 10–15(–16) µm, pale yellowish-brown, with homogenous content; wall thin (ca. 0.5 µm), uniform, smooth. In squashed spore balls the spores appear irregularly reticulate due to the remnants of the thin, fragile spore walls of the sterile cells. Sterile cells between the spores irregular, polyhedral, 2.5–8 µm long, empty, with thin wall (ca. 0.2 µm), of the same colour as the spores. Cortical cells (Figs. 4, 6) variable in form and size, irregular, in surface view 4–13.5 x 5–20(–22) µm, somewhat darker than the spores; wall 0.5–1.5 µm thick, smooth.

The *Entyloma* species of *Eleocharis* (Cyperaceae).

Three *Entyloma* species have been described on different *Eleocharis* species. The study of these resulted in the recognition of two species: *E. eleocharidis* (Sawada) Ling ex Ling, and *E. parvum* J. J. Davis.

Entyloma eleocharidis (Sawada) Ling ex Ling, 1949:255.

Ustilago eleocharidis Sawada, 1943:39 (nomen nudum; ICBN 36.1). — Type on *Eleocharis dulcis* Trin., Rep. China (Taiwan, Formosa), Taipei, 16.XI.1934, K. Sawada. Isotype in HUV 12056!

Entyloma eleocharidis M. S. Pavgi & R. A. Singh, 1968(1969):424 (later homonym). — Type on *Eleocharis plantaginea* R. Br., India, Uttar Pradesh, Varanasi, 5.X.1964, M. S. Pavgi & R. A. Singh. Topotype: 15.XII.1967, R. A. Singh (HUV 15995!)

Figs. 3–6. *Burrillia sagittariae* K. & C. Vánky on *Sagittaria planitiana* Agostini (type). Bar for fig. 3 = 100 µm, bars for figs. 4–6 = 10 µm.

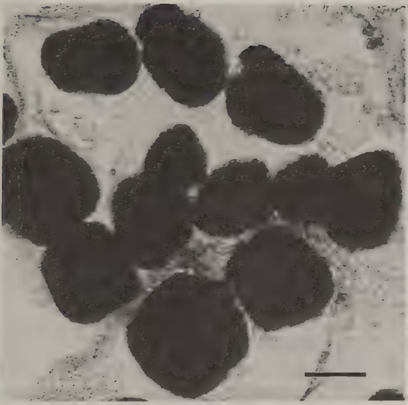
Fig. 3. Spore balls in the host tissue.

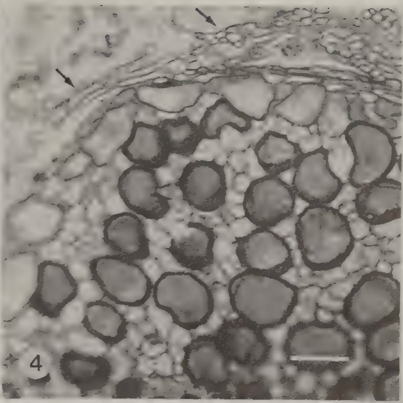
Fig. 4. Part of a sectioned spore ball showing the dark (stained) spores more or less separated by thin-walled, small, sterile cells and the discontinuous cortex of large sterile cells and also mycelia (arrows).

Fig. 5. Squashed spore ball. Spores with remnants of the cell walls of the fragile sterile cells as irregular reticulum of the spores.

Fig. 6. Cortical cells of a squashed spore ball in surface view.

Figs. 7–8. Spores of *Ustilago ctenioides* K. Vánky in LM and in SEM (type). Bars = 10 µm and 5 µm, respectively.

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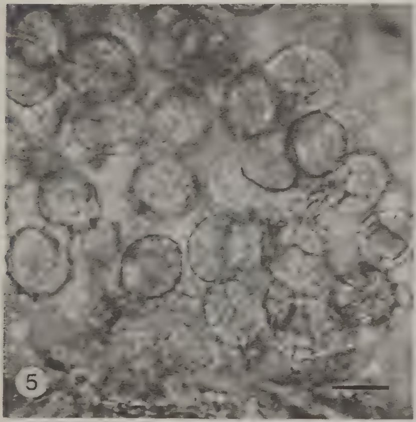
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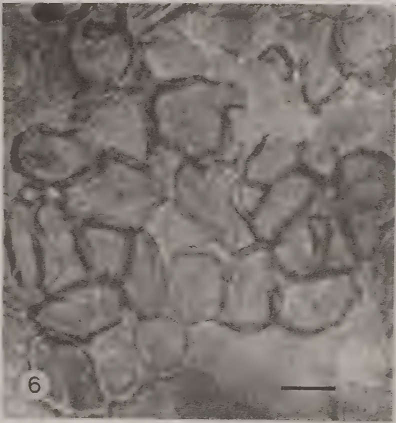
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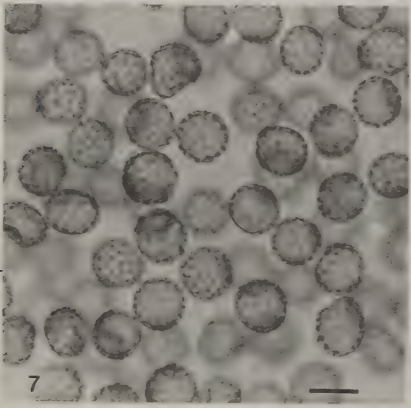
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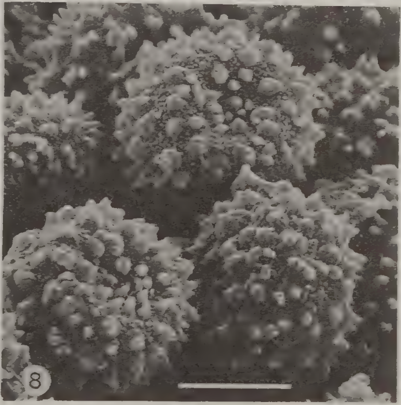
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Sori on the culms as circular to oval spots, 0.1–1.5 mm in diameter, or larger and irregular by confluence, lead-coloured, non-erumpent. Spores embedded in the host tissue, subepidermal, agglutinated in rather permanent groups or parallel columns in the intercellular spaces of the mesophyll; single spores subpolyhedrally irregular, rarely subglobose, 7–11 x 9–13(–15) µm, light olivaceous-brown; wall even or slightly uneven, 0.8–1.5 µm thick, smooth. Germination (Pavgi & Singh, 1968(1969), 1969, 1970) results in aseptate basidia bearing an apical whorl of 2–6 subcylindrical, hyaline basidiospores measuring 2.2–2.5 x 7.5–20 µm. Basidiospores conjugate in situ giving rise to ellipsoidal or falcate secondary sporidia, 0.7–1.2 x 2.5–7.5 µm.

A comparison of the isotype of *Entyloma eleocharidis* (Sawada) Ling ex Ling with the topotype of *E. eleocharidis* M. S. Pavgi & R. A. Singh, collected and kindly sent to me by Professor R. A. Singh, did not reveal any essential differences in the sorus and spore characters. Consequently, the two specimens are considered to represent the same species.

Entyloma parvum J. J. Davis, 1919:715.

Lectotype on *Eleocharis acicularis* (L.) Roemer & Schultes, USA, (selected by Zundel, 1953:263) Mass., Cambridge, 1906, coll. Grossenbacher (WIS!). Syntypes: Wisc., Madison, 18.VIII.1890 ("1892"), coll. L. S. Cheney (WIS!); Wisc., Portage Co., Plover, 24.VIII.1917, J. J. Davis (BPI 176158!, WIS!).

Sori on the culms as small, black, fusiform, 0.3–0.5(–1) mm long pustules usually comprising the whole width of the filiform culms. Spores aggregated, rather firmly agglutinated, variable in shape and size, subpolyhedrally irregular, rarely subglobose or ovoid, 5.5–9.5 x 6.5–10.5 µm, smoky tinted yellowish-brown; wall thin (ca. 0.5 µm), smooth.

Key to the *Entyloma* species of *Eleocharis*.

– Sori circular to oval, spores 9–13(–15) µm long .... *E. eleocharidis*
– Sori linear or fusiform, spores 5.5–10.5 µm long .... *E. parvum*

A new smut fungus of *Dactyloctenium* (Gramineae).

The study of a sample of *Dactyloctenium ctenioides* (Steud.) Bosser, apparently infected by the rather common *Ustilago sparsa* Underwood, revealed that it is contaminated by a still undescribed smut fungus:

Ustilago ctenioides K. Vánky, **sp. nov.**

Typus in matrice *Dactyloctenium ctenioides* (Steud.) Bosser, Island of Reunion, St. Gilles, clearing in a *Casuarina* forest at "Hermitage", 6.VI.1974, leg. Th. Cadet. Holotypus in Herbario Ustil. Vánky (HUV 17117!).

Sori (Fig. 2) in ovariis, paene perfecte involucris floralibus cooperti, ovoidei, cca. 1–1,5 x 1,5–2 mm, membrana tenui, cinereo-brunnea cooperti; eadem rupta massam atrobrunneam, pulveream sporarum ostendentes. Spiculae tantum nonnullae eiusdem inflorescentiae infectae. Sporae (Figg. 7, 8) globosae, subglobosae, late ellipsoideae vel ovoideae, (8–)9–10,5 x 9–12(–13) µm, rufobrunneae; pariete cca. 1 µm crasso, dure denseque verrucoso-echinulato.

Sori (Fig. 2) in ovaries, almost completely hidden by the floral envelopes, ovoid, ca. 1–1.5 x 1.5–2 mm, covered by a thin, greyish-brown membrane which ruptures disclosing the dark brown, powdery mass of spores. Only few spikelets of an inflorescence are infected. Spores (Figs. 7, 8) globose, subglobose, broadly ellipsoidal or ovoid, (8–)9–10.5 x 9–12(–13) µm, reddish-brown, wall ca. 1 µm thick, coarsely, densely verrucose-echinulate.

Ustilago ctenioides differs from the more common *U. sparsa* Underwood (type on *Dactyloctenium aegyptium* (L.) Beauv., USA) by the spore measurements and ornamentation. These in the latter species are 6–10 µm and finely, sparsely punctate-verruculose.

Sydow (1929:418) described *Ustilago eleusines* H. Sydow (type on *Eleusine indica* (L.) Gaertn., China) destroying the spikes, having 2–3 cm long sori and verrucose spores of 7–10 x 8–11 µm in diameter. Unfortunately, this name is a later homonym (not *U. eleusinis* Kulkarni, 1922:186, type on *Eleusine coracana* (L.) Gaertn., India). The difference between the names "*eleusines*" and "*eleusinis*" is small, of grammatical character, and has to be considered as orthographic variants. Mundkur (1940:333) discovered the homonymy and, without seeing the type, renamed Sydow's species as *Ustilago sydowiana* Mundkur, and considered it identical with the fungus collected by Sultan Ahmad in Punjab on *Dactyloctenium sindicum* Boiss. However, the fungus of *D. sindicum* was described one year earlier under the name of *Ustilago idonea* H. Sydow, in Sydow & Ahmad, 1939:442 (type on *Eleusine aristata* Ehrenb. = *Dactyloctenium sindicum* Boiss., India). If Mundkur's statement of synonymy is correct, the valid name of *U. eleusines* H. Sydow should be *Ustilago idonea* H. Sydow. To elucidate this problem, study of the type specimens is necessary.

The recognised seven species of Ustilaginales on *Dactyloctenium* are: *Tilletia dactyloctenii* K. Vánky, *T. eleusines* H. Sydow, *Ustilago ctenioides* K. Vánky, *U. dactyloctenii* P. Hennings, *U. dactylocteniophila* P. Hennings, *U. idonea* H. Sydow, and *U. sparsa* Underwood.

Key to the smut fungi of *Dactyloctenium*.

1. Spores more than 15 µm long 2
– Spores less than 15 µm long 3
2. Spores echinulate-reticulate, muri weak .... *T. dactyloctenii*
– Spores reticulate, muri well-developed .... *T. eleusines*
3. Sori in the whole inflorescence. Spores 7–11 µm long .... *U. idonea*
– Sori not in the whole inflorescence 4
4. Sori in the spikes, horn-shaped. Spores 10–14 µm long .... *U. dactyloctenii*
– Sori in the spikelets or ovaries, not horn-shaped 5
5. Sori in the spikelets. Spores 9–14 µm long, finely, sparsely punctate-echinulate .... *U. dactylocteniophila*
– Sori in the ovaries 6
6. Spores 9–13 µm long, coarsely verrucose-echinulate .... *U. ctenioides*
– Spores 6–10 µm long, finely, sparsely punctate-verruculose .... *U. sparsa*

Three new *Thecaphora* species on Compositae from South America.

The genus *Thecaphora* Fingerhuth is characterised by loose to permanent spore balls composed only of spores. Type: *T. hyalina* Fingerh. (=*T. seminis-convolvuli* (Desm.) Ito) in the seeds of *Calystegia* and *Convolvulus* species. The spore balls are produced in different organs of the host plants forming a yellow, orange or reddish-brown, granular-powdery mass. About 43 species of *Thecaphora* are known parasitising members of 15 host plant families: 14 spp. on Compositae, 11 spp. on Leguminosae, 4 spp. on Amaranthaceae, 2 spp. on Primulaceae, 2 spp. on Cyperaceae, and one species each on Boraginaceae, Convolvulaceae, Liliaceae, Molluginaceae, Nyctaginaceae, Polygonaceae, Restionaceae, Rubiaceae, Solanaceae, Umbelliferae. *Thecaphora* species on Gramineae could not be confirmed (Vánky & Berbee, 1988). Durán (1982) monographied the *Thecaphora* species of Compositae in North America recognising 11 species. Vánky (1991) revised the *Thecaphora* species of Leguminosae recognising 11 species. The 14 known species of *Thecaphora* on Compositae are: 1. *T. burkartii* Lindquist (1953:112), type on *Elvira biflora* (L.) DC., Bolivia. 2. *T. californica* (Harkness) G. P. Clinton (1902:146), type on *Grindelia robusta* Nutt., USA. 3. *T. cuneata* (Schofield) G. P. Clinton (1902:146), type on *Grindelia squarrosa* (Pursh.) Dunal, USA. 4. *T. denticulata* R. Durán (1982:1517), type on *Bidens pilosa* L. var. *radicata* Schulz. Bip., Mexico. 5. *T. heliopsidis* R. Durán (1982:1520), type on *Heliopsis annua* Hemsl., Mexico. 6. *T. hennenea* R. Durán (1982:1520), type on *Melampodium divaricatum* (Rich.) DC., Mexico. 7. *T. lagenophorae* (McAlpine) McAlpine (1910:185), type on *Lagenophora emphysopus* Hook. fil., Tasmania (Australia). 8. *T. melampodii* R. Durán (1982:1520), type on *Melampodium gracile* Less., Mexico. 9. *T. mexicana* Ellis & Everhart, in Clinton (1902:146), type on *Guardiola platyphylla* A. Gray, Mexico. 10. *T. neomexicana* R. Durán (1982:1521), type on *Baltimora recta* L., Mexico. 11. *T. pilulaeformis* Berk. & Curtis, in Berkeley (1874:58), type on *Bigelowia veneta* H., B. & K. (= *Haplopappus venetus* (H., B. & K.) Blake), USA. 12. *T. pulcherrima* R. Durán (1970:1099), type on *Baltimora recta* L., Mexico. 13. *T. pustulata* G. P. Clinton, in Chardón (1921:23), type on *Bidens pilosa* L., Puerto Rico, and 14. *T. trailii* Cooke (1883:155), type on *Carduus heterophyllus* L., Great Britain.

From this enumeration results that *Thecaphora* species on Compositae are known only on host plants belonging to the Asteroideae subfamily, none on Cichorioideae. They are restricted to hosts in the tribes Heliantheae (with 9 *Thecaphora* spp.), Astereae (with 4 spp.), and Cardueae (with one *Thecaphora* species). The same host plant genus may be parasitised by two (or more?) *Thecaphora* species, e. g., *T. californica* and *T. cuneata* on *Grindelia*, *T. denticulata* and *T. pustulata* on *Bidens*, *T. hennenea* and *T. melampodii* on *Melampodium*, or *T. neomexicana* and *T. pulcherrima* on *Baltimora*. In the last case, even the same sample of *Baltimora recta* is parasitised by these two smuts. Of the remaining 6 species of *Thecaphora* each is described from host plants belonging to a certain genus, except *T. trailii* which occurs on species of three related host genera of the tribe Cardueae: *Carduus*, *Cirsium*, and *Saussurea*. Of the 14 known *Thecaphora* species on Compositae 12 were described from the American continent, one from Europe and one from Australia (Tasmania).

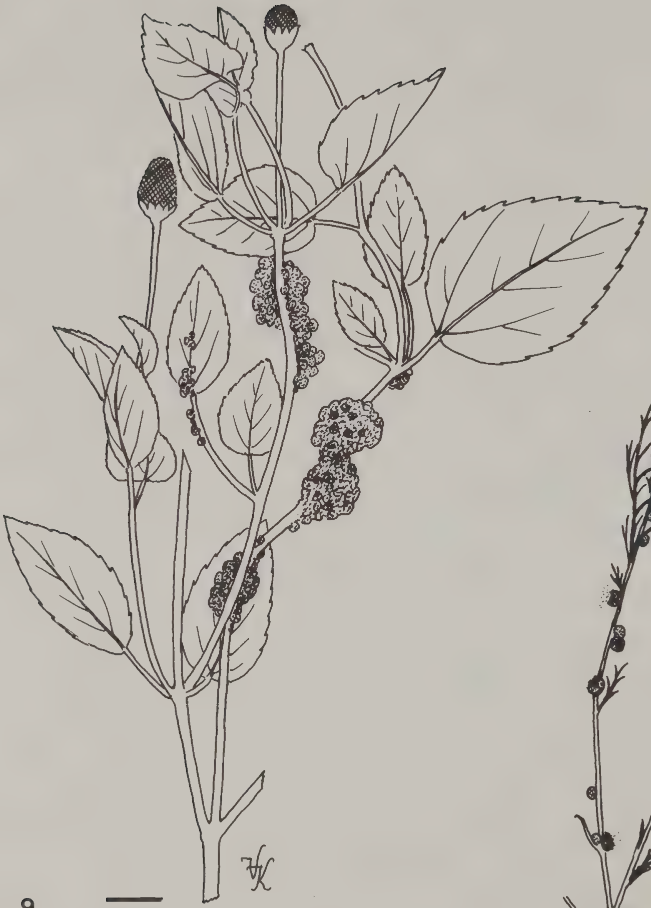
Freire (1986) published a *Thecaphora* species on *Spilanthes oleracea* L. from Brazil describing the symptoms, the spore balls, the spores and the spore germination of this fungus which he suspected to be a new species. However, Dr. Freire, very correctly, did not name his *Thecaphora* without comparing it with other *Thecaphora* species. Dr. Francisco C. O. Freire kindly sent me a reprint of his paper and freshly collected material. The study of this fungus and its comparison with other *Thecaphora* species on Compositae showed that it is an undescribed species for which the following name is proposed:

Thecaphora spilanthes Freire & K. Vánky, **sp. nov.**

Typus in matrice *Spilanthes oleracea* L. (*Acmella oleracea* (L.) R. K. Jansen; Compositae, subfam. Asteroideae, tribe Heliantheae), Brazil, State of Pará, urbs Belém, 1°28' S, 48°27' W, alt. ca. 13 m, 7.VI.1991, leg. J. E. U. de Carvalho. Holotypus in Herbario Ustil. Vánky (HUV 15268!), isotypi in BPI and in UB.

Sori (Fig. 9) gallae polycysticae caulium, petiolorum, foliorum, minus frequenter caulium inflorescentiarum, diametro 1–2 mm, propter coalescentiam usque 6 cm longae, 2–3 cm latae et 1 cm altae, primo virides deinde brunneae, superficie irregulari, saepe distortionem plus-minus conspicuam partim affectarum matricis efficientes. Mature telae tegentes matricis dehiscentes, vel sori disrupti ostendentes massam glomerulorum sporarum aurantiaco-brunneam, granuloso-pulveream, post dispersionem earum structuram alveolarem telarum matricis relinquentium. Glomeruli sporarum (Figg. 12, 13) subglobosi, ovoidei, ellipsoidales usque aliquid irregulares, 15–35 x 20–45 µm, flavi usque flavo-brunnei, e sporis 2–15(–20) firmiter unitis compositi. Sporae (Figg. 12, 13) polyedricae, hemisphaericae vel late cuneiformes, raro elongatae, lateribus contingentibus deplanatae, latere libero rotundatae, 10–16 x 11–20(–25) µm, dilute flavae usque pallide flavo-brunneae; pariete laterum contingentium tenui (cca. 0,5 µm), levi, ipso lateris liberi crassiore (1,5–2,5 µm), dense, irregulariter verrucoso, verrucis 0,5–1 µm altis, saepe 2 vel nonnullis earum coalescentibus. Germinatio sporarum (Fig. 11) basidium simplex vel bifurcatum saepe cum intumescentia basali instructum efficiens. E cellulis basidii hyphae excurrentes; processus basidiosporarum non observatus.

Sori (Fig. 9) as polycystic galls on stems, petioles, leaves, less frequently on inflorescence stalks, from 1–2 mm in diameter to 6 cm long by coalescence, 2–3 cm wide and 1 cm high, first green later brown, with irregular surface, often causing more or less expressed distortion of the affected parts of the host plant. At maturity, the covering host tissues rupture or the sori crack disclosing the orange-brown, granular-powdery mass of spore balls which are dispersed leaving behind an alveolar structure of host tissues. Spore balls (Figs. 12, 13) subglobose, ovoid, ellipsoidal to somewhat irregular, 15–35 x 20–45 µm, yellow to pale yellowish-brown, composed of 2–15(–20) firmly united spores. Spores (Figs. 12, 13) polyhedral, hemispherical or broadly cuneiform, rarely elongated, with flattened contact sides and rounded free side, 10–16 x 11–20(–25) µm, light yellow to pale yellowish-brown; wall of contact sides thin (ca. 0.5 µm), smooth, that of free side thicker (1.5–2.5 µm), densely, irregularly verrucose, warts 0.5–1 µm high, often two or several warts coalescing. Spore germination



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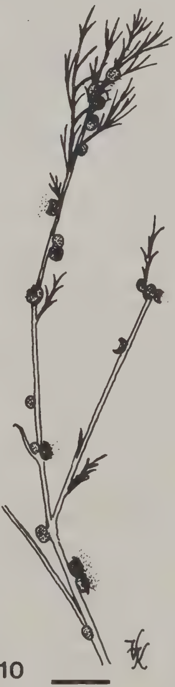

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Fig. 9. Sori of *Thecaphora spilanthes* Freire & K. Vánky on *Spilanthes oleracea* L. (type).

Fig. 10. Sori of *Thecaphora ambrosiae* K. Vánky on *Ambrosia artemisioides* Meyen & Walp. (type). Bars = 1 cm

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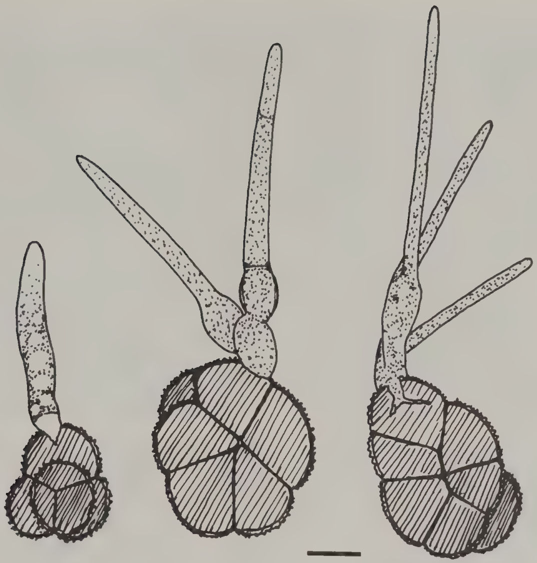


Fig. 11. Spore germination of *Thecaphora spilanthes* (reproduced from Freire, 1986:552). Bar = 10 µm.

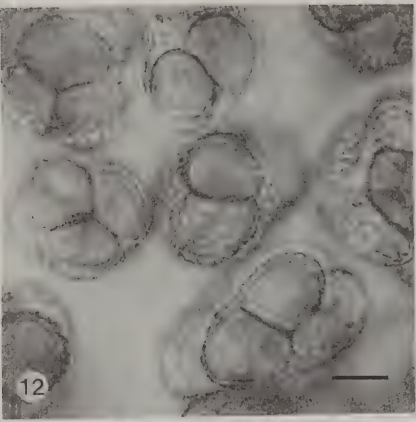
(Fig. 11; on WA, at 24–28 °C, after 3 days; Freire, 1986:551) results in a simple or bifurcate basidium, often with a basal swelling. From basidial cells hyphae arised; development of basidiospores was not observed.

Spilanthes oleracea L. is native to the Amazon region and widely cultivated for culinary, medicinal, insecticidal and ornamental purposes. It is used as spice for preparation of local foods for its interesting, bitterish taste. The *Thecaphora*-disease of *S. oleracea* is rather common around Belém and may cause severe losses, or plants of bad quality (comp. Freire, 1986:544).

Thecaphora ambrosiae K. Vánky, **sp. nov.**

Typus in matrice *Ambrosia artemisioides* Meyen & Walp. (*Franseria meyeriana* Schultz Bip., det. E. P. Killip; Compositae, subfam. Asteroideae, tribe Heliantheae), Peru, Arequipa Dep., Arequipa, 16°25' S, 71°32' W, 11.VI.1920, leg. E. W. D. & M. M. Holway. Holotypus in BPI (178909), isotypus in Herbario Ustil. Vánky (HUV 13630!).

Sori (Fig. 10) pustulae parvae globoideae caulium et petiolorum, diametro 1,5–2,5 mm, solitarii vel 2–3 eorum acervati, brunnei, primo tela matricis cooperti, mature illa rupta massam glomerulorum sporarum cinnamomeo-brunneam, granulosam-pulveream ostendentes. Glomeruli sporarum (Figg. 14, 15) subglobosi usque ovoidei, 22–36 x 23–40 µm, pallide flavo-brunnei, e sporis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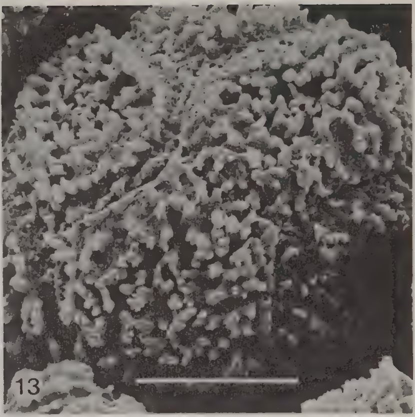
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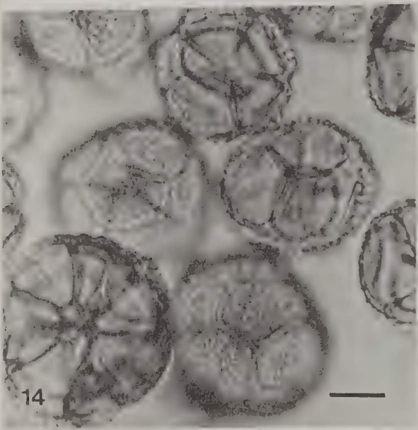
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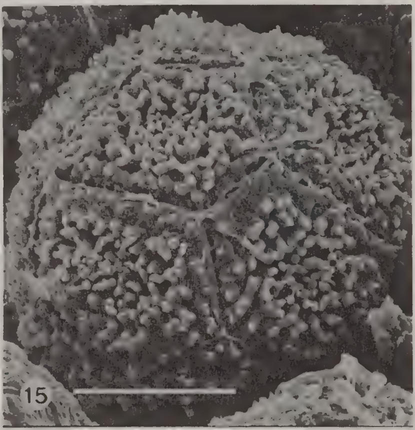
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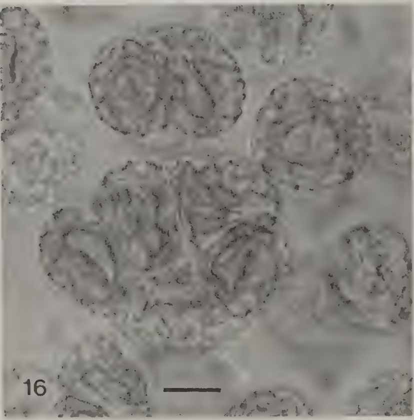
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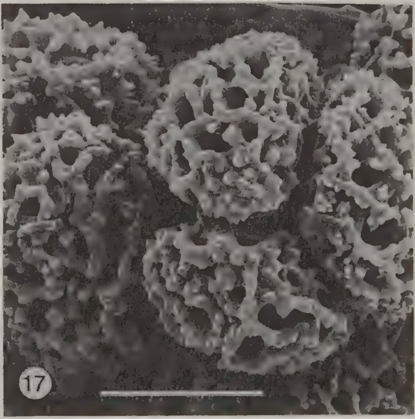
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6–16(–20) firmiter unitis compositi. Sporae (Figg. 14, 15) radiolariter dispositi subpolyangulariter irregulares, vel late subcuneiformes, cum superficie rotundata et lateribus contingentibus deplanatis, visu superficiali 9,5–14,5 x 12–16 µm, in sectione transversa media 9,5–17,5 µm longae, pallide flavobrunneae; parietibus contingentibus tenuibus (cca. 0,5 µm), levibus, illis liberis 2,5–3 µm crassis, satis dense irregulariter verrucosis, verrucis 1–1,5 µm altis, rotundatis, subacutis vel acuminatis, 2–3 earum forte acervatis vel coalescentibus.

Sori (Fig. 10) as small globoid pustules on stems and petioles, 1.5–2.5 mm in diameter, solitary or 2–3 are grouped, brown, first covered by host tissue which ruptures at maturity disclosing the cinnamon-brown, granular-powdery mass of spore balls. Spore balls (Figs. 14, 15) subglobose to ovoid, 22–36 x 23–40 µm, pale yellowish-brown, composed of 6–16(–20) firmly united spores. Spores (Figs. 14, 15) subpolyhedrally irregular or broadly subcuneiform with rounded free surface and flattened contact sides, in surface view 9.5–14.5 x 12–16 µm, in optical median view 9.5–17.5 µm long, radially disposed, pale yellowish-brown; contact wall thin (ca. 0.5 µm), smooth, free wall 2.5–3 µm thick, rather densely, irregularly verrucose, 2–3 warts may be grouped or coalescent, warts 1–1.5 µm high, rounded, subacute or acuminate.

The Colombian uredinologist, Mr. V. M. Pardo-Cardona (Universidad Nacional de Colombia, Medellin), sent me some smut fungi, collected by him, for identification. Between these was a still unknown *Thecaphora* species:

Thecaphora polymniae K. Vánky & Pardo-Cardona, **sp. nov.**

Typus in matrice *Polymnia riparia* H., B. & K. (*Smallanthus riparius* (H., B. & K.) H. Robinson; Compositae, subfam. Asteroideae, tribe Heliantheae), Colombia, dept. de Antioquia, Ituango, suburb "Chapineros", road to the TV antenna, 7°07' N, 75°46' W, alt. ca. 1500 m, 22.IX.1994, leg. V. M. Pardo-Cardona. Holotypus in Herbario Ustil. Vánky (HUV (17240), isotypi in MMUNM (606/483) and in BPI.

Sori (Fig. 18) in caulibus, petiolis et venis foliorum (hypophylli), pustulas formantes prominentes, acervatas, globoideas, diametro usque 3 cm vel maiores, primo virides serius brunneas, per telas matricis coopertas, mature ruptas, massam pallide cinnamomeo-brunneam, pulveream sporarum et glomerulorum sporarum ostendentes. Sporae (Fig. 17–17) singulae vel in glomerulis, magnitudine 20–30 x 22–44 µm, laxis, e sporis 2–4(–8) compositis. Sporae

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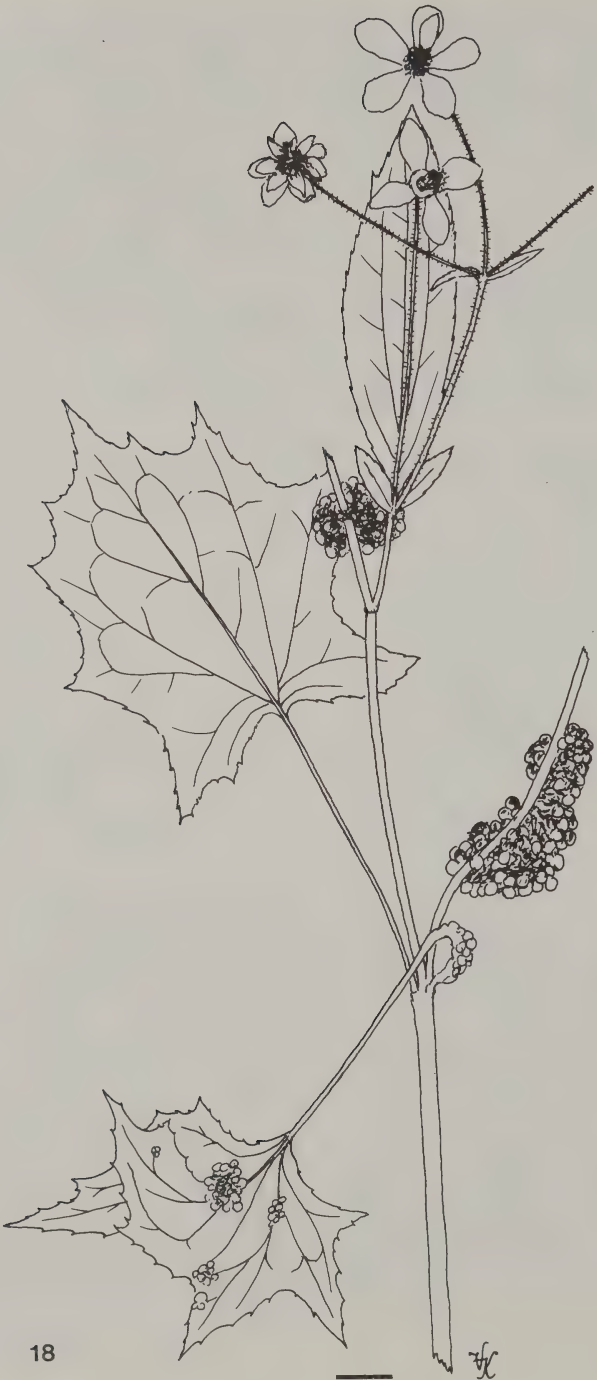
Figs. 12, 13. Spores and spore balls of *Thecaphora spilanthes* Freire & K. Vánky on *Spilanthes oleracea* L. (type), in LM and in SEM.

Figs. 14, 15. Spores and spore balls of *Thecaphora ambrosiae* K. Vánky on *Ambrosia artemisioides* Meyen & Walp. (type), in LM and in SEM.

Figs. 16, 17. Spores and spore balls of *Thecaphora polymniae* K. Vánky & Pardo-Cardona on *Polymnia riparia* H., B. & K. (type), in LM and in SEM.

Bars = 10 µm.



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globosae, subglobosae, ellipsoidales, elongatae vel irregulares, semiglobosae vel subcuneiformes cum lateribus deplanatis 1 vel nonnulis, 13–17,5 x 16–25 µm, dilute flavae usque pallide flavo-brunneae; pariete laterum contingentium pro ratione tenui (1–3 µm), illo laterum liberorum crasso (4–6,5 µm), cum processibus magnis et latis peculiariter ornato. Processus illi plerumque coalescentes et exemplum singulare cerebriforme vel irregulariter reticulatum cum interspatiis angustis altisque, praeter hoc superficiem eorum verrucis parvis sparsim dispositis efformantes.

Sori (Fig. 18) on stems, petioles and leaf veins (hypophyllous) forming prominent, clustered, globoid pustules from 1–2 mm in diameter to 3 cm or larger, first green later brown, covered by host tissues which rupture at maturity to disclose the light cinnamon-brown, powdery mass of spores and spore balls. Spores (Figs. 16, 17) single or in loose spore balls measuring 20–30 x 22–44 µm, composed of 2–4(–8) spores. Spores globose, subglobose ellipsoidal, elongated or irregular, hemiglobose or subcuneiform with one or several flattened sides, 13–17.5 x 16–25 µm, light yellow to pale yellowish-brown; wall on the contact side relatively thin (1–3 µm), on the free side thick (4–6.5 µm), peculiarly ornamented by large and wide processes. These processes usually coalesce to form a cerebriform or irregularly reticulate pattern with narrow and deep interspaces. Additionally, the surface is provided with sparsely situated, small warts.

The smut fungi of *Andropogon bicornis* (Gramineae).

Four smut fungi were described from *Andropogon bicornis* L.: 1. *Tolyposporella brunkii* (Ellis & Galloway) G. P. Clinton, 2. *Sporisorium culmiperdum* (Schröter) K. Vánky, 3. *Sporisorium holwayi* (G. P. Clinton & Zundel) K. Vánky, and 4. *Sphacelotheca bicornis* (P. Hennings) Zundel. The study of recently collected samples of this last species also shows the characters of a *Sporisorium*:

Sporisorium bicornis (P. Hennings) K. Vánky, **comb. nov.**

Basionym: *Ustilago bicornis* P. Hennings, in Pazschke, Hedwigia 35:50, 1896. — *Sphacelotheca bicornis* (P. Henn.) Zundel, 1930:140. — Type on *Andropogon bicornis* L., Brasilia, Campo Bello, IV.1894, E. Ule (2079).

Sori in considerably swollen ovaries, long-cylindrical, 0.5–1 x 10–30 mm, curved, first covered by a thick, brown, fungal peridium which ruptures from its distal part disclosing the chocolate-brown, powdery mass of spores and a well-developed central columella. Sori affect usually all ovaries of a few racemes of an inflorescence and may produce witches' brooms, in appearance resembling *Sporisorium holwayi*. Spores in loose spore balls, when mature single, globose, subglobose, ovoid, ellipsoidal or slightly irregular, 6–9.5 x 6.5–11(–12) µm yellowish-brown; wall 0.5–1 µm thick, moderately densely punctate to

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Fig. 18. Sori of *Thecaphora polymniae* K. Vánky & Pardo-Cardona on stems, petioles and leaf veins of *Polymnia riparia* H., B. & K. (type). Bar = 1 cm.

echinulate. Sterile cells few between the spores, variable in shape and size, 4–12 µm long, hyaline, thin-walled (ca. 0.5 µm), smooth, forming shorter or longer chains.

Key to the Ustilaginales of *Andropogon bicornis*

1. Sori on the inner surface of the leaf sheaths .... *Tolyposporium brunkii*
– Sori in the inflorescence 2
2. Sori in the whole inflorescence. Spores 16–20 µm long............ *S. culmiperdum*
– Sori in considerably hypertrophied ovaries, spores smaller.............................*3*
3. Spores 11–16 µm long, dark reddish-brown; wall 1.5–2.5 µm thick ..*S. holwayi*
– Spores 6.5–12 µm long, yellowish-brown; wall 0.5–1 µm thick ....*S. bicornis*

Ustilaginales of *Iseilema* (Gramineae).

The genus *Iseilema* (subfam. Panicoideae, tribe Andropogoneae) differs from *Themeda*, i. a., in having pedicellate, deciduous involucral spikelets and a very short, obtuse callus of the fertile spikelets rather than sessile, not deciduous involucral spikelets and pointed callus of the fertile spikelets in *Themeda*. (For raceme structure of *Themeda* see Vánky, 1994:154). Four smut fungi could be recognised on *Iseilema*:

Sporisorium mitchellii (H. & P. Sydow) K. Vánky, **comb. nov.**
Basionym: *Ustilago mitchellii* H. & P. Sydow, Ann. Mycol. 1:23, 1903. — Type on *Iseilema mitchellii* Anderss., S. Australia, Mt. Lyndhurst, leg. M. Koch (BPI 188941!).

Sori comprising the racemes, cylindrical, ca. 1 x 3–6 mm, first covered by a brown peridium which disintegrates from the apex exposing a blackish-brown, semi-powdery spore mass intermixed with sterile cells, surrounding a simple, 3–6 mm long central columella. Spore balls many-spored, loose, irregular, easily disintegrating. Spores globose, subglobose, ovoid, ellipsoidal to subpolyhedrally irregular, 7–11 x 9–13.5 µm, reddish-brown; wall uniform, ca. 1 µm thick, densely and finely echinulate. Sterile cells variable in shape and size, subglobose, ellipsoidal or irregular, with flattened sides, 8–16(–20) µm long, pale yellowish-brown, single, in chains or in irregular groups, collapsed in old specimens; wall 1.5–2.5 µm thick, smooth.

Sporisorium iseilematis (H. & P. Sydow & Butler) K. Vánky, **comb. nov.**
Basionym: *Ustilago iseilematis* H. & P. Sydow & Butler, Ann. Mycol. 4:426, 1906. — *Sphacelotheca iseilematis* (H. & P. Sydow & Butler) Mundkur & Thirum., in Thirumalachar, 1950a:172. — *Sphacelotheca iseilematis* (H. & P. Sydow & Butler) Zundel, 1953:95. — Type on *Iseilema laxum* Hackel, India, Madras, Samalkota, 27.VIII.1902, C. A. Barber (HCIO 446!).

Sphacelotheca apludae-aristatae Rao & Nema, 1975(1980):103. — Type on "*Apluda aristata* L." (= misnamed *Iseilema laxum* Hackel, teste I. Scholz), India, Madhya Pradesh, Krishinagar in Jabalpur, 12.XII.1964, G. K. Rao. — Holotype in Herb. Dept. Plant Pathology, J. N. Agricultural University, Jabalpur, M. P., India; isotype in HUV (15358!).

Sori comprising the racemes, all racemes of an inflorescence are affected, sori cylindrical, partly hidden by the spatheolae, first covered by a thick, brown, fungal peridium which early ruptures from its apex disclosing the dark brown, powdery mass of decomposed spore balls intermixed with sterile cells, and a central, simple, flagelliform, 5–15 mm long columella. Spores subglobose to ellipsoidal, rarely slightly irregular, 6.5–9 x 7–10 µm, yellowish-brown; wall even, ca. 0.8 µm thick, moderately densely, finely echinulate. Sterile cells larger than the spores, 8–18 µm long, single or usually in irregular groups, hyaline, smooth, collapsed in old specimens.

There are variations in spore measurements of different samples, ranging from (5.5–)6.5–9 x 6.5–9.5 to 7–9.5 x 8–11(–12) µm.

Sporisorium inayati (H. & P. Sydow & Butler) K. Vánky, **comb. nov.**
Basionym: *Ustilago inayati* H. & P. Sydow & Butler, Ann. Mycol. 5:486, 1907. — *Sphacelotheca inayati* (H. & P. Sydow & Butler) Mundkur & Thirum., in Thirumalachar, 1950a:172. — Type on *Iseilema laxum* Hackel, India, United Provinces, Orai farm, 26.II.1907, leg. Inayat (HCIO 722!).

Sori in the spikelets of a few racemes in the inflorescence, often affecting all four involucral spikelets of a raceme leaving intact the central spikelet (awn present!), but rarely also the central spikelet can be infected. Sori ovoid to cylindrical, ca. 1 x 2–3 mm, covered by a thick, light brown peridium which early dehisces disclosing the dark brown, powdery mass of spore balls and spores intermixed with sterile cells and a short, often shortly branched central columella. Spore balls many-spored, loose, subglobose, elongate to irregular, easily decomposing into single spores. Spores globose, subglobose to ovoid, 8–10.5(–11) x (8–)9–12(–13) µm, reddish-brown; wall uniform, ca. 1 µm thick, densely, prominently echinulate. Sterile cells single or in irregular groups, subglobose, ellipsoidal, semiglobose to irregular, 8–15 µm long, subhyaline to pale yellowish-brown; wall ca. 1 µm thick, smooth.

Sporisorium thirumalacharii K. Vánky, **nom. nov.**
Replaced name: *Sorosporium iseilematis* Thirumalachar, Loydia 13:175, 1950b (not *Sporisorium iseilematis* (H. & P. Sydow & Butler) K. Vánky, opus praesens). — Type on *Iseilema laxum* Hackel, India, Mysore, Nandi Hills, 28.XI.1948 (published as 28.XI.1949; HCIO 18801!).

Sori in racemes, long cylindrical, partly hidden by the spatheolae, 0.5–1 x 10–15 mm, first covered by a brown, rather thick peridium which ruptures irregularly disclosing the dark brown, somewhat agglutinated mass of spore balls, sterile cells and a simple, central columella. All racemes of an inflorescence or only portion of an inflorescence may be affected, causing shortened internodes and stiff, upturned leaves imparting a witches' broom appearance. Spore balls many-spored, semi-permanent, ovoid to irregular, 85–170 x 110–200 µm, reddish-brown. Outer spores subglobose, ovoid to subpolyhedrally irregular, 7–11 x 8–12(–13.5) µm, reddish-brown, with minutely verruculose, ca. 1 µm thick wall. Inner spores subpolyhedrally irregular, 7–9 x 8–13 µm, pale yellowish-brown, with apparently smooth, thin (ca. 0.5 µm) wall. Sterile cells

6–13 µm long.

The host identity of the type could not be verified on the material at hand.

Key to the smut fungi of *Iseilema*.

1. The fungus produces witches' brooms .... *S. thirumalacharii*
– The fungus does not produce witches' brooms 2
2. Sori in the spikelets of some racemes of an inflorescence .... *S. inayati*
– Sori in all racemes of an inflorescence..*3*
3. Spores 7–10 µm long, finely echinulate....................................... *S. iseilematis*
– Spores 9–13.5 µm long, prominently echinulate .... *S. mitchellii*

The smut fungi of *Stenotaphrum* (Gramineae).

At least nine smut fungus names were published from different *Stenotaphrum* species. Some of these are synonyms, others are later homonyms. Three species could be recognised of which one is recombined into *Sporisorium*. A fourth, *Ustilago stenotaphri* McAlpine, seems to be a *Cintractia* species and, consequently, its host must be a member of the Cyperaceae family.

Ustilago affinis Ellis & Everhart, in Cockerell, 1893:297.
Type on *Stenotaphrum americanum* Schrank (= *S. secundatum* (Walt.) O. Kuntze), Jamaica, Mandeville.

Ustilago americana Spegazzini, 1899:207. — Type on *Stenotaphrum glabrum* Trin. (= *S. dimidiatum* (L.) Brongn.), Argentina, La Plata, II.1890, and Uruguay, near Montevideo, winter 1893, coll. J. A. Arechavaleta (no type designated).

Ustilago stenotaphri Massee, 1899:184 (non *U. stenotaphri* McAlpine, 1895, nec P. Hennings, 1898). — Type on *Stenotaphrum glabrum* Trin. (= *S. dimidiatum* (L.) Brongn.), Island of Bermuda, coll. Cummins (NY!).

Sori in all spikelets, isolated or more or less merged, at first partly hidden by enveloping leaf sheaths, protected by a thin, greyish-brown membrane which ruptures disclosing the olive-brown, powdery spore mass. Finally, only the naked rachis of the spike is left behind. Spores subglobose, ovoid to slightly irregular, 5.5–8 x 6–10 µm, yellowish-brown; wall uniform, thin (ca. 0.5 µm), very finely punctate. Groups of thin-walled, hyaline, sterile cells, of which origin and taxonomic significance is unclear, may be present between the spores.

Some differences in spore measurements, observed in samples from various parts of the world, are considered to lie within the variation of this species.

Sporisorium henningsii (Saccardo & P. Sydow) K. Vánky, **comb. nov.**
Basionym: *Ustilago henningsii* Saccardo & P. Sydow, in Saccardo, Sylloge fungorum 16:368, 1902. — *Ustilago stenotaphri* P. Hennings, 1898b:293 (non *U. stenotaphri* McAlpine, 1895, nec Massee, 1899). — Type on *Stenotaphrum glabrum* Trin. (= *S. dimidiatum* (L.) Brongn.), South West Africa, Namibia, Windhoek, alt. 450 feet, VII.1896, F. R. R. Schlechter. Isotypes in Plantae Schlechterianae Austro-Africanae, Iter secundum (HUV 3147! & 12917!).

Sori comprise the whole inflorescence, cylindrical, 1.5–2.5 x 15–35 mm, partly hidden by the terminal leaf sheath, first covered by a greyish-brown peridium which ruptures irregularly disclosing the dark brown mass of spore balls and several long, filiform columellae. Spore balls loose, many-spored (up to several hundred), subglobose, ellipsoidal to irregular, 35–90 x 50–160 µm, dark reddish-brown. Spores subglobose, ovoid to usually subpolyhedrally irregular, 5–6.5 x 5.5–7 µm, light yellowish-brown; wall uniform, thin (ca. 0.5 µm), sparsely verrucose-echinate, which only slightly affects the spore profile.

Ustilago bouriquetii Maublanc & Roger, in Roger, 1934:327.
Type on *Stenotaphrum complanatum* Schrank (= *S. dimidiatum* (L.) Brongn.), Madagascar, Nanisana, 1931, G. Bouriquet (PC!).

Sphacelotheca mauritiana Zundel, 1944:405. — Type on *Stenotaphrum secundatum* (Walt.) O. Kuntze. (= misidentified *S. dimidiatum* (L.) Brongn., teste K. Vánky), Mauritius, near Reduit, about 1941, coll. E. F. S. Shepherd (BPI 178071!).

Sorosporium stenotaphri G. Viennot-Bourgin, 1963:43 (nomen novum superfluum pro *Ustilago bouriquetii*). — On *Stenotaphrum glabrum* Trin. (= *S. dimidiatum* (L.) Brongn.), Madagascar, Tamatave Reg., Ivoloina, 24.III.1962, G. Viennot-Bourgin (PC!).

Sori (Fig. 19) in the considerably hypertrophied filaments as 1–1.5 mm wide, 10–20(–50) mm long tubes, three per each infected flower of the host plant. Exceptionally, sori also in somewhat hypertrophied ovaries. Mature sori split longitudinally on their distal part. After the brown, powdery spore mass is scattered, the covering membrane of host origin remains as a twisted, greyish-brown band on a shorter or longer, still tubular basal part. Aborted anthers may be attached to the apex of young sori. Columella absent but shreds of host vessels may be present in some of the sori. Spores variable in shape and size, globose, subglobose, ovoid to slightly irregular, 5–8.5 x 5.5–10.5 µm, yellowish-brown; wall uniform, thin (ca. 0.5 µm), finely, moderately densely punctate-verruculose which does not or only little affect the spore profile, in SEM verruculose-echinulate. Few, irregular groups of subhyaline, thin-walled (ca. 0.5 µm), 5–10 µm long sterile cells may be present between the spores, collapsed in old specimens. The spores are formed by the division of the sporogenous hyphae by transversal septa. Very young spores are ellipsoidal, thin-walled, smooth and catenulate. Spore germination (on water agar, at room temperature, within a few hours) results in a 4-celled basidium (1.5 x 17–30 µm) on which laterally and terminally, on short sterigmata, ellipsoidal to elongated basidiospores are produced measuring 0.8–1(–1.5) x 3–12 µm. In cultures, the basidiospores bud successively from their apex producing white coloured yeast colonies.

The very short time necessary for the spore germination of *Ustilago bouriquetii* is unusual and probably is a biological adaptation. I presume that the infection takes place through the stigma where the spores germinate. The parasitic hyphae penetrate through the style and ovary to the base of the flower and reach the still dormant androeceum within a relatively short time (1–2 days?), where they infect the filaments. This presumption, however, must be verified.

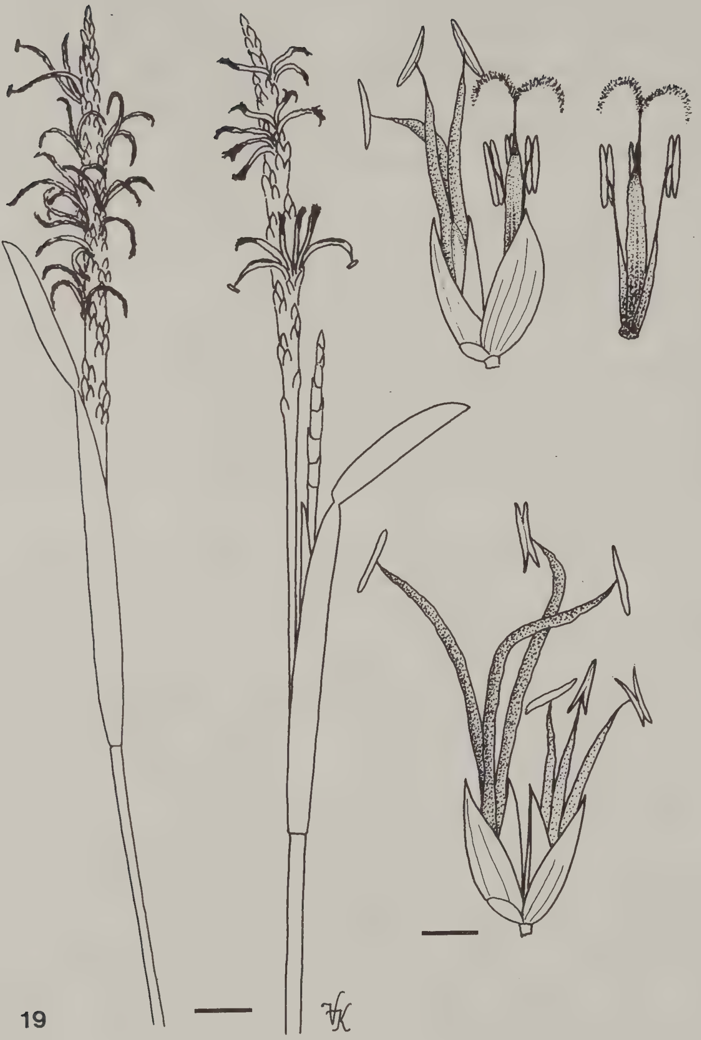

Fig. 19. Sori of *Ustilago bouriquetii* Maublanc & Roger in the filaments of *Stenotaphrum dimidiatum* (L.) Brongn. Enlarged two infected spikelets each with two flowers. In one flower, as an exceptio, even the gynoeceum is infected (Reunion I., near St. Paul, 18.XII.1944, coll. C. & K. Vánky; HUV 17106). Bars = 1 cm and 2 mm, respectively.

(?) ***Ustilago stenotaphri*** McAlpine, 1895:758.

Type on "*Stenotaphrum dimidiatum*" (L.) Brongn., Australia, Victoria, Kew, VI.1890, coll. Ralph, comm. J. Barnard (VPRI 3202).

The symptoms caused by this fungus, described by McAlpine (1910:161), are: "Produced on the stem and leaves, giving them a blackened appearance, as if charred. Spore-mass black, compact, continuous, completely surrounding part attacked, which is usually the younger growth." Spores slightly flattened, in side view ellipsoidal (ca. 10–13 µm wide), in plane view subglobose, ellipsoidal or subpolyhedrally irregular, 10–15 x 12–18.5 µm, reddish-brown; wall of uneven thickness, 0.5–2 µm wide, thickest at the angles, from apparently smooth to finely and densely punctate-verrucose.

I did not see plants infected by *U. stenotaphri* McAlp. The type specimen, sent in loan, contained only a few leaves of a healthy plant. The leaves successively narrow into acute leaf tips and do not represent *Stenotaphrum dimidiatum.* Spores, taken from the envelope, could be studied. The spore characters, given above, suggest rather a *Cintractia* species (from a certain Cyperaceae) than a *Ustilago* species from the surface of a grass (comp. also the culm smuts of Gramineae, in Vánky, 1990:273). Study of the sorus structure is necessary to clarify this problem.

Key to the smut fungi of *Stenotaphrum.*

1. Sori on the leaves and stems .... (?) *Ustilago stenotaphri*
– Sori in the flowers 2
2. Sori in the whole inflorescence. Columella present....... *Sporisorium henningsii*
– Sori not comprising the whole inflorescence. Columella absent......................*3*
3. Sori comprise the spikelets. Spores finely punctate...................*Ustilago affinis*
– Sori in the filaments. Spores punctate-verruculose............ *Ustilago bouriquetii*

Ustilago affinis **var.** ***hilariae*** **=** ***U. hilariicola.***

Hennigs (1898a:267) described a new smut fungus, *Ustilago hilariae* on *Hilaria cenchroides* H., B. & K. (Gramineae, tribe Zoysieae) from Mexico. Unfortunately, this name is a later homonym of *U. hilariae* Ellis & Tracy (1890:77), another fungus with type on *Hilaria jamesii* (Torr.) Benth., USA, New Mexico, Albuquerque, 17.VI.1887, S. M. Tracy (BPI 160870 & 160871!). Fischer & Hirschhorn (1945) discussed Hennings' species and some *Stenotaphrum* smuts and considered the first one to be a variety of *Ustilago affinis* (type on *Stenotaphrum secundatum* (Walt.) O. Kuntze; tribe Paniceae). G. W. Fischer (1952:10) described a new species: *Ustilago hilariicola.* A comparison of the types revealed that Hennings' and Fischer's species represent the same fungus. On the other hand, the study of several *Stenotaphrum* and *Hilaria* smuts showed marked differences between them which, in my opinion, justify to treat Hennings' fungus at species level as:

Ustilago hilariicola G. W. Fischer, 1952:10.
Type on *Hilaria jamesii* (Torr.) Benth., USA, Nevada, Wabuska, 23.VI.1947, G. W. Fischer, J. P. Meiners and R. Sprague. Isotypes in Fischer, Gramin. smuts N. Amer. No. 214 (HUV 9939!).

Ustilago hilariae P. Hennings, 1898a:267 (not Ellis & Tracy, 1890). — *Ustilago affinis* Ellis & Tracy var. *hilariae* (P. Hennings) G. W. Fischer & Hirschhorn, 1945:318. — Type on *Hilaria cenchroides* H., B. & K., Mexico, near Mexico city, 2.X.1896, E. W. D. Holway (BPI 157006! as *U. affinis* var. *hilariae*).

Sori, similarly to *Ustilago affinis* Ellis & Ev., destroy the spikelets, isolated or more or less merged, at first protected by a thin, greyish-brown membrane which ruptures disclosing the dark brown, powdery spore mass, leaving the naked rachis behind. Sometimes only the basal part of the spikelets is destroyed. Spores subglobose to ellipsoidal, (4–)5–7 x 5–7(–8) µm, yellowish-brown, with a tendency to be somewhat lighter coloured on one side in some of the spores; wall thin (ca. 0.5 µm), finely punctate-verruculose, in SEM sparsely verrucose.

Ustilago hilariicola resembles *U. affinis* but differs from it especially in having smaller, more prominently ornamented spores. The spores in *U. affinis* are 5.5–8 x 6–10 µm, very finely punctate. The host plants of these two smuts also belong to widely different tribes of Gramineae.

SYNONYM

Sphacelotheca sacciolepidis = *Sporisorium manilense.*

H. & P. Sydow (1912:77) described *Ustilago manilensis* on *Panicum indicum* L. Thirumalachar (1950b:173) described a fungus on *Sacciolepis indica* (L.) Chase, under the name of *Sphacelotheca sacciolepidis*, which name was transferred by Vánky (1993:41) into the genus *Sporisorium.* However, *Panicum indicum* L. is a synonym of *Sacciolepis indica* (L.) Chase. This fact gave me the idea to compare the descriptions and the type specimens of these two fungi. This left no doubt that *U. manilensis* and *S. sacciolepidis* represent the same species. The correct name and synonyms of this smut are:

Sporisorium manilense (H. & P. Sydow) K. Vánky, **comb. nov.**
Basionym: *Ustilago manilensis* H. & P. Sydow, Ann. Mycol. 10:77, 1912. — *Sphacelotheca manilensis* (H. & P. Sydow) Ling, 1950:78. — Type on *Panicum indicum* L. (= *Sacciolepis indica* (L.) Chase), Philippine Islands, Luzon I., near Manila, X.1910, E. D. Merrill (7419; BPI 163271!). Topotype: Manila, 12.XI.1911, E. D. Merrill (8416; BPI 163270!).

Sphacelotheca sacciolepidis Thirumalachar (as "*saccolepidis*"), 1950b:173. — *Sporisorium sacciolepidis* (Thirum.) K. Vánky, 1993:41. — Type on *Sacciolepis indica* (L.) Chase, India, Mysore, Bhadravati, 18.VIII,1947, H. C. Govindu (HCIO 18808!).

For description of this species, under the name of *Sporisorium sacciolepidis,* see Vánky (1993:41).

CORRECTION

Vánky (1985:15) based his new combination of *Anthracoidea pannucea* (Liro) K. Vánky on *Cintractia pannucea* Liro, Ann. Bot. Soc. Zool.-Bot. Fenn. "Vanamo" 6:5, 1935. However, Liro's name is a nomen nudum (ICBN 36.1). Later, Liro (1939:109) himself validated the name of *C. pannucea*, giving for it a Latin description. Consequently, the correct basionym and literature citation for *Anthracoidea pannucea* (Liro) K. Vánky is: *Cintractia pannucea* Liro, Mycotheca fennica. Die Etiketten. No. 301–600, pg. 109, 1939.

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*THE GENUS **MACALPINOMYCES*** (USTILAGINALES) *

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ABSTRACT

The study of the monotypic genus *Macalpinomyces* Langdon & Fullerton (Ustilaginales) and of some recently collected smut fungi resulted in the emendation of the genus and recognition of further four *Macalpinomyces* species: *M. sharmae* K. Vánky (type on *Panicum sumatrense* and *Setaria pallide-fusca*), *M. tripogonis* (M. S. Patil) K. Vánky, comb. nov. (type on *Tripogon bromoides*), *M. eragrostiellae* K. & C. Vánky, sp. nov. (type on *Eragrostiella bifaria*), and *M. zonotriches* K. Vánky, sp. nov. (type on *Zonotriche inamoena*). The relationship of this genus, similarities with and differences to *Ustilago* (Persoon) Roussel, *Sporisorium* Ehrenberg ex Link, and *Endosporisorium* K. Vánky are discussed. A key to the species of *Macalpinomyces* is given.

INTRODUCTION

The genus *Macalpinomyces* was introduced by Langdon & Fullerton (1977:30) for *Sorosporium eriachnes* Thümen, type on *Eriachne* sp. (Gramineae, subfam. Panicoideae, tribe Eriachneae). Langdon & Fullerton (1977) studied the ontogeny and mature structure of sori of *Sorosporium eriachnes* and demonstrated that a separate genus is necessary to accommodate it. The new genus was characterised by "Sori with a peridium composed of hyphae associated with cells of the host plant. Spores mostly irregularly polyangular, sometimes globose, or subglobose, pigmented. Giant cells thick-walled, mixed with the spores. Type species: *Macalpinomyces eriachnes* (Thümen) Langdon & Fullerton" (translated from the original, Latin diagnosis).

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MATERIALS AND METHODS

Material used for studies of the sorus structure, spore morphology and spore germination, was taken from the type collections preserved in the author's herbarium (Herb. Ustil. Vánky, HUV).

For light microscopical (LM) studies, dried spores were rehydrated in lactophenol by gently heating to boiling point. For scanning electron-microscopical (SEM) studies, dried spores were dusted on double-sided adhesive tape, mounted on specimen stub, sputter-coated with gold-palladium, ca. 20 nm, and examined in a SEM at 10 kV.

For studies of the soral characters, freshly collected young sori or rehydrated old sori were fixed in 2% glutaraldehyde in 0.1 M Na-cacodylate buffer at pH 7.2 for several days. After six transfers in 0.1 M Na-cacodylate buffer, the material was postfixed in 1% osmiumtetroxide in the same buffer for 1 h in the dark, washed in distilled water, and stained in 1% aqueous uranyl acetate for 1 h in the dark. After five washes in distilled water, the material was dehydrated in acetone series, embedded in Spurr's plastic and sectioned with a diamond knife. Semi-thin sections were stained with new fuchsin and crystal violet, mounted in "Entellan" and studied in a light microscope.

For the study of germination, spores were spread thinly on water agar (WA), in Petri dishes, kept at room temperature (ca. 20 °C) and at 29 °C. As soon as basidiospores were produced, a suitable piece of medium (about 10 mm square) was cut out, transferred to a slide, and covered with a coverglass. A small droplet of lactophenol with cotton blue added to the side of the square of medium, fixed and stained the basidia and basidiospores.

Studying Ustilaginales collected in India, I came across three graminicolous smut fungi which cannot be included with certainty in any known genus but they stand close to *Macalpinomyces*. One of these was recently described as *Macalpinomyces sharmae* K. Vánky (1995a:223) from the ovaries of *Panicum sumatrense* Roth ex Roem. & Schult. and *Setaria pallide-fusca* (Schumacher) Stapf & C. E. Hubb. Another one was described by M. S. Patil (1992:182) under the name of *Tolyposporium tripogonis*, and also by R. V. Gandhe, N. D. Sharma & K. Vánky (in Vánky, 1993:34) under the name of *Sporisorium tripogonis*. *Macalpinomyces sharmae* and *Tolyposporium tripogonis* differ from the type of the genus *Macalpinomyces, M. eriachnes,* in spore measurements and in the characters of the sterile cells. The spores of *M. sharmae* measure 6.5–9 x 7–10.5(–11) µm, in *T. tripogonis* 8–11 x 8.5–13 µm whereas these in *M. eriachnes* are 8–12 x 10–19 µm. The sterile cells in *M. sharmae* and *T. tripogonis* are thin-walled (ca. 1, respectively ca. 0.5 µm) and measure 9–12 x 11–17 µm in *M. sharmae*, respectively 4–10(–14) µm in length in *T. tripogonis*. In *M. eriachnes* the sterile cells are thick-walled (up to 5 µm) and "giant" (11–26 x 18–32 µm). For all three of these species, and also for *M. eragrostiellae* the peculiar sorus structure with tightly packed mass of polyangular spores filling the ovaries is common. In this spore mass, single or grouped sterile cells are embedded and scattered. The sterile cells may be of different size with varying wall thickness.

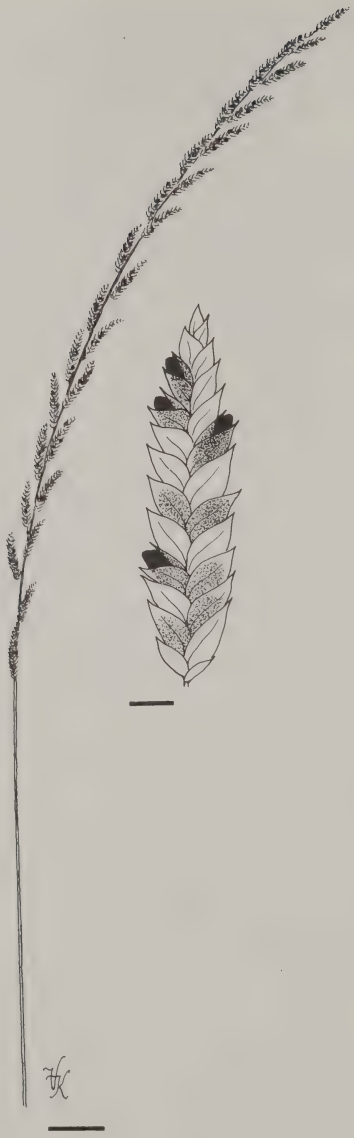
A further species with close affinity to *Macalpinomyces*, but lacking giant, thick-walled sterile cells, instead possessing thin-walled, relatively small sterile cells aggregated in balls, was discovered in the seeds of *Eragrostiella bifaria*. It is not identical to any earlier known species and is therefore described as:

Macalpinomyces eragrostiellae K. & C. Vánky, **sp. nov.**

Typus in matrice *Eragrostiella bifaria* (Vahl) Bor (Gramineae, subfam. Chloridoidae, tribe Eragrostidae; det. S. G. Pradhan, BSI), India, Madhya Pradesh, 9 km S.E. urbe Jabalpur, Tropical Forest Research Institute, 23°07' N, 80°00' E, alt. ca. 390 m, 13.X.1992, leg. N. D. Sharma, S. R. Singh, R. P. Mishra, M. B. Nagar and C. & K. Vánky (unacum *Tilletia eragrostiellae* K. & C. Vánky & N. D. Sharma). Holotypus in Herbario Ustil. Vánky (HUV 16974!), isotypi in BPI and in Vánky, Ust. exs. (ineditus).

Sori (Fig. 1) in ovariis in inflorescentia dispersis, inconspicui, ovoidei, 1 x 1,5(–2) mm, atro-olivaceobrunnei, peridio tenue cooperti, massa agglutinata sporarum una cum cellularum sterilium dispersim in eam immissis impleti (Fig. 3). Peridium e pericarpio et e strato tenui hypharum compositum, mature irregulariter rupto massam semiagglutinatam usque granulosam-pulveream sporarum cum globulis cellularum sterilium immixtis ostendens. Massa sporarum atro-rufobrunnea, satis facile dissolubilis in globulos irregulares magnitudine diversos, polysporos (pluries decem usque pluries centum) sporarum vel in sporas singulas. Sporae (Figg. 4, 5) polyedricae vel subpolyedrice irregulares, 7–10 x 8–11(–12) µm, rufobrunneae; pariete inaequaliter incrassato, 0,5–1,5 µm crasso, conspicue levi usque valde minute denseque punctato, sub SEM dense minuteque verruculoso. Globuli cellularum sterilium (Fig. 4) globoidei vel irregulares, 25–55 x 25–70 µm, satis permanentes, subhyalini usque pallide flavobrunneo tincti. Cellulae steriles singulae globosae, ovoideae, ellipsoidales vel parum irregulares, intus homogeneae, 4–8 x 5–9,5 µm; pariete 0,5–1 µm crasso, levi. Germinatio sporarum (Fig. 9; in agaro aquoso, in una die, 29° C) cum basidiis 4-cellularibus (una cellularum forte in spora remanens), magnitudine cca. 2 x 25–70 µm. Basidiosporae ad basidia terminaliter et ad septa lateraliter in sterigmatibus productae ovoideae usque elongato-ellipsoidales, 1,5–2 x 3,5–9 µm.

Sori (Fig. 1) in ovaries, scattered in the inflorescence, inconspicuous, ovoid, 1 x 1.5(–2) mm, dark olivaceous-brown, covered by a thin peridium and filled with an agglutinated mass of spores in which scattered balls of sterile cells are embedded (Fig. 3). The peridium, which is composed of the pericarp and a thin layer of hyphae, ruptures irregularly at maturity disclosing the semiagglutinated to granular-powdery mass of spores intermixed with balls of sterile cells. Spore mass dark reddish-brown, rather easily decomposing into irregular, variably large, many-spored (tens to hundreds) groups or into single spores. Spores (Figs. 4, 5) polyhedrally or subpolyhedrally irregular, 7–10 x 8–11(–12) µm, reddish-brown; wall unevenly thickened, 0.5-1.5 µm wide, from apparently smooth to very finely and densely punctate, in SEM densely and finely verruculose. Balls of sterile cells (Fig. 4) globoid or irregular, 25–55 x 25–70 µm, rather persistent, subhyaline to pale yellowish-brown tinted. Single sterile cells globose, ovoid, ellipsoidal or slightly irregular, 4–8 x 5–9.5 µm, content homogenous, wall



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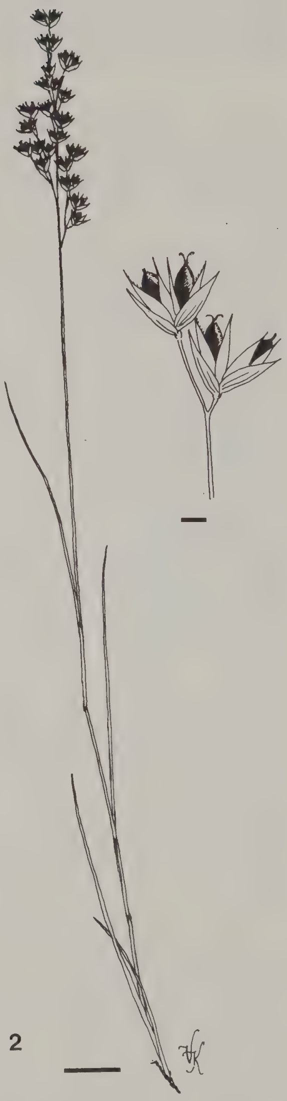

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Fig. 1. Sori of *Macalpinomyces eragrostiellae* K. & C. Vánky in some of the ovaries of *Eragrostiella bifaria.* (Type). Habit, and an enlarged spikelet with nine sori of which five are completely hidden by the floral envelopes.

Fig. 2. Sori of *Macalpinomyces eriachnes* (Thümen) Langdon & Fullerton in the ovaries of *Eriachne* sp. (Type). Habit, and enlarged spikelets.

Bars = 1 cm and 1 mm, respectively.

0.5--1 µm thick, smooth. Spore germination (Fig. 9; on WA, in one day, at 29 °C) results in 4-celled basidia (of which the proximal cell may remain in the spore), measuring ca. 2 x 25–70 µm. On the basidia ovoid to long-ellipsoidal basidiospores measuring 1.5–2 x 3.5–9 µm are produced on sterigmata, laterally at the septa and terminally.

Macalpinomyces sharmae K. Vánky, 1995a:223.

Type on *Panicum sumatrense* Roth ex Roem. & Schult., India (HUV 16054!), isotypi in BPI (802367) and in Vánky, Ust. exs. (inedited). Paratype on *Setaria pallide-fusca* (Schumacher) Stapf & C. E. Hubb., India (HUV 16053!).

For description and illustration of this species see Vánky, 1995a:223-225.

Macalpinomyces tripogonis (M. S. Patil) K. Vánky, **comb. nov.**

Basionym: *Tolyposporium tripogonis* M. S. Patil, Indian Phytopathol. 45:182, 1992 (as "*tripogonae*") – Type on *Tripogon bromoides* Roem. & Schult., India, M. S., Kolhapur Distr., Panhala, 10.XI.1987, coll. S. R. Yadav (HCIO 30114), isotypes in Bot. Dept. Shivaji Univ., Kolhapur, India, and in HUV 17454!.

Sporisorium tripogonis R. V. Gandhe, N. D. Sharma & K. Vánky, in Vánky, 1993:34. – Type on *Tripogon jacquemontii* Stapf, India, Madhya Pradesh, 25 km E.N.E. of Jabalpur, near the water reserve, alt. 500 m, 10.X.1992, coll. N. D. Sharma et al. (HUV 15424!); isotypi in Vánky, Ust. exs. No. 857.

Also on *Tripogon capillatus* Jaub. & Spach, India (HUV 17455).

For description and illustration of this species see Vánky, 1993:34-36.

According to Langdon & Fullerton (1977:29) "The formation of giant cells prior to and concurrently with sporulation is a characteristic which excludes the *Eriachne* smut from existing genera of Ustilaginaceae". Following the examination of the type species of *Macalpinomyces* and also the above-mentioned three additional species, the original description of the genus is altered as follows:

Macalpinomyces Langdon & Fullerton, **emend.** K. Vánky

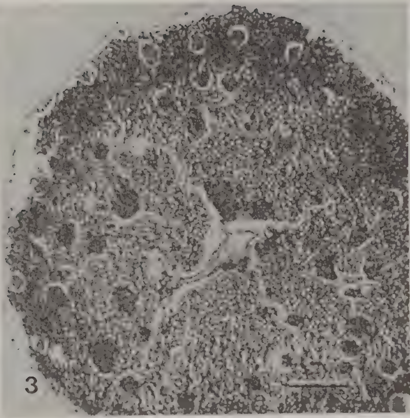
Macalpinomyces, Langdon & Fullerton, Trans. Brit. Mycol. Soc. 68:30, 1977.

Sori in ovaries of Gramineae, covered by a peridium permeated by hyphae. No columella. Sori filled with pigmented, tightly packed, polyangular spores. Single or grouped, hyaline or pale coloured sterile cells of variable size and wall-thickness are embedded and scattered in the spore mass. At maturity, the spore mass is decomposing into irregular groups of variable size or into single spores. Spore germination of *Ustilago*-type. Typus generis:

Macalpinomyces eriachnes (Thümen) Langdon & Fullerton, 1977:30.

Sorosporium eriachnes (as *"eriachnis"*) Thümen, 1878:443. – *Ustilago australis* Cooke, 1879:34. – Type of both names is *Eriachne* sp., Australia, Northern Territory, Fitzmaurice River, X.1855, coll. F. von Meuller (HUV 1663!).

Sori (Fig. 2) in ovaries, ovoid to ellipsoidal with a short, acute tip bearing the rest of the stigma, 2–3 x 3–4 mm, covered by a brown peridium composed of the pericarp, permeated by inter- and intracellular hyphae, and an internal, thin layer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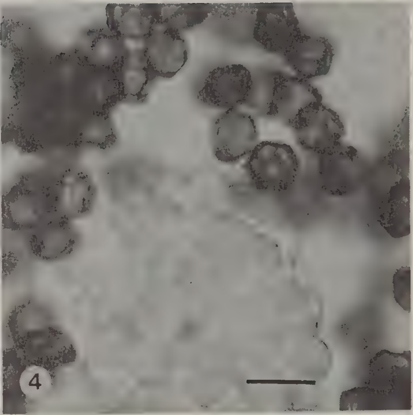
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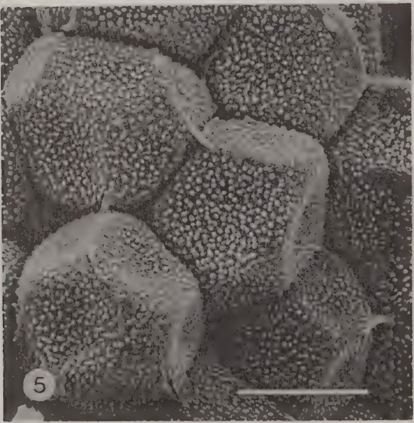
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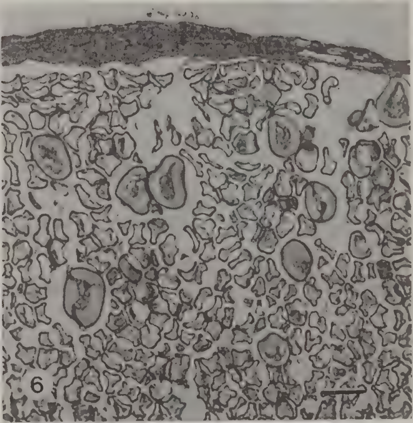
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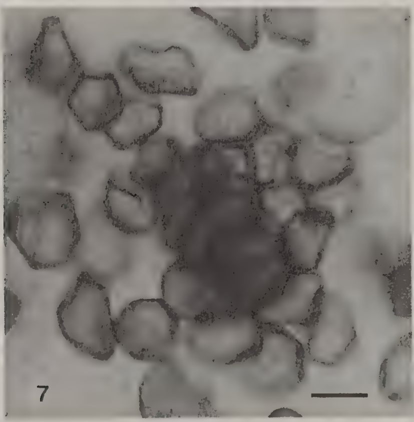
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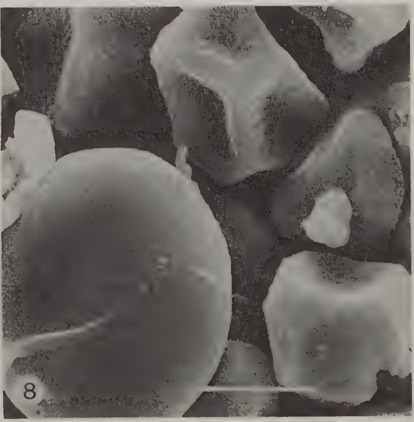
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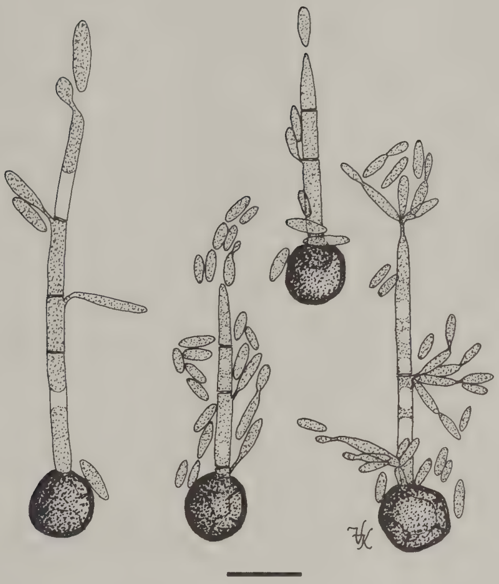

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Fig. 9. Germinating spores of *Macalpinomyces eragrostiellae* K. & C. Vánky. Septate, 4-celled basidia (of which the proximal cell may remain in the spore) produce ovoid to long-ellipsoidal basidiospores on sterigmata, laterally at the septa and terminally. (Type). Bar = 10 µm.

Figs. 3–5. Sorus, spores and sterile cells of *Macalpinomyces eragrostiellae* K. & C. Vánky. Type (HUV 16974).

Fig. 3. Transverse section of a sorus showing the external layer of pericarp and the spore masses filling the sori in which groups of darker (stained) balls of sterile cells are embedded. Bar = 100 µm.

Fig. 4. Spores and a ball of sterile cells in LM. Bar = 10 µm.

Fig. 5. Spores in SEM. Bar = 5 µm.

Figs. 6–8. Sorus, spores and sterile cells of *Macalpinomyces eriachnes* (Thümen) Langdon & Fullerton. Type (HUV 1663). Bars = 10 µm.

Fig. 6. Part of a transverse section of a sorus with peridium and the spores (mostly collapsed), between them single or small groups of large, sterile cells.

Figs. 7–8. Spores, groups of spores and giant sterile cells in LM and in SEM.

of hyphae producing the spores and sterile cells. The sori are filled with a mass of tightly packed spores in which single or grouped giant sterile cells are scatteredly embedded (Fig. 6). Spore mass blackish-brown, semiagglutinated, rather easily decomposing into irregular, variably large, many-spored groups or into single spores. No columella. Spores (Figs. 7, 8) mostly polyhedrally or subpolyhedrally irregular, 8–12 x 10–19 µm, cinnamon-brown; wall ca. 1 µm thick, smooth or minutely granular. Sterile cells (Figs. 7, 8) globose, subglobose or slightly irregular, large, measuring 11–26 x 18–32 µm, pale yellowish-brown, with thick (up to 5 µm wide), smooth wall and a granular content. Germination of overwintered spores resulted partly in simple or branched, septate hyphae or in two- to four-celled basidia, 1–3 per spore, with fusiform basidiospores in varying numbers arising from each cell (Langdon & Fullerton, 1977:29).

On Gramineae: *Eriachne agrostidis* F. Mueller, *E. aristata* F. Mueller, *E. ciliata* R. Br., *E. helmsii* Domin, *E. melicacea* F. Mueller, *E. mucronata* R. Br., *E. muelleri* Domin, *E. pallescens* R. Br., *E. rara* R. Br., *E. scleranthoides* F. Mueller, and *E.* sp., Australia and the Philippine Islands.

Recently, I discovered between specimens obtained in exchange from the late Professor Zambettakis a further *Macalpinomyces:*

Macalpinomyces zonotriches K. Vánky, **sp. nov.**

Typus in matrice *Zonotriche inamoena* (K. Schum.) W. D. Clayton (*Tristachya inamoena* K. Schum., Gramineae, subfam. Panicoideae, tribe Arundinellae), Africa, N. Rhodesia, 10.V.1957, leg. A. Angus. Holotypus in IMI 70722!, isotypus in. Herbario Ustil. Vánky (HUV 17388!). Paratypus: Rhodesia, N. of Kafue, Shimabala, 30.IV.1961, leg. A. Angus (IMI 90027!, HUV 17389!).

Sori (Figg. 10, 11, 12) in nonnullis ovariis hypertrophicis unius spiculi, in inflorescentia dispersi, forma cornu similes vel cylindrici apice subacuto, cca. 1,5–2,5 x 10–15 mm, flavobrunnei, peridio primo crassiusculo deinde minute hispidulo, origine matricali hyphisque intermixtis cooperti, serius irregulariter rupto massam nigrobrunneam, semiagglutinatam usque pulveream sporarum cum cellulis sterilibus intermixtam ostendenti. Columella nulla. Massa sporarum in catervas irregulares sporarum vel sporas singulas dissoluta. Sporae (Figg. 13, 14) subpolyedriter irregulares, rarius subglobosae vel ellipsoidales, magnitudine variabiles, 4–8 x 5–9 µm (sporae subglobosae diametro 4,5–8 µm), flavobrunneae; pariete aequali, tenui (cca. 0,5 µm), minute denseque (ex obliquo non vel vix conspicue) punctato-verruculoso. Cellulae steriles (Figg. 13, 14) subglobosae usque late ellipsoidales, 12–28 x 14–30 µm, hyalinae, contentu minute granuloso, pariete (4–)5–6.5(–7) µm crasso, levi, homogeneo vel aliquantum stratoso.

Sori (Figs. 10, 11, 12) in some hypertrophied ovaries of a spikelet, scattered in the inflorescence, horn-shaped or cylindrical with subacute tips, ca. 1.5–2.5 x 10–15 mm, yellowish-brown, first covered by a thick, finely hispid peridium of host origin intermixed with hyphae which ruptures irregularly to disclose the semiagglutinated to powdery, blackish-brown mass of spores intermixed with "giant" sterile cells. No columella. Spore mass easily disintegrates into irregular groups or into single spores. Spores (Figs. 13, 14) subpolyhedrally irregular,

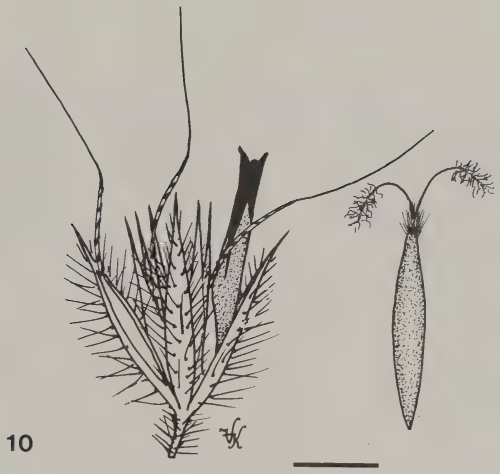
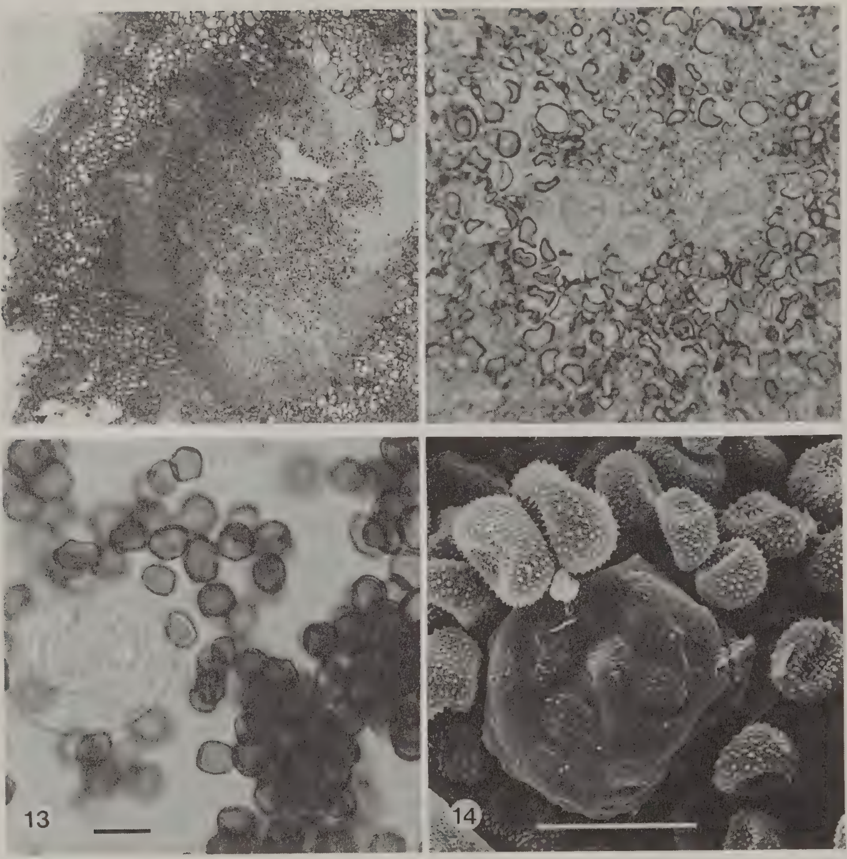


Fig. 10. A spikelet of *Zonotriche inamoena* (K. Schum.) W. D. Clayton with a sorus of *Macalpinomyces zonotriches* K. Vánky, and a separated young sorus. (Type). Bar = 0.5 cm.

more rarely subglobose or ellipsoidal, variable in size measuring 4–8 x 5–9 µm (subglobose spores 4.5–8 µm in diameter), yellowish-brown; wall uniform, thin (ca. 0.5 µm), finely, densely punctate-verruculose which does not or just slightly affect the spore profile. Sterile cells (Figs. 13, 14) subglobose to broadly ellipsoidal, 12–28 x 14–30 µm, hyaline, with (4–)5–6.5(–7) µm thick, homogenous or few-layered, smooth wall and a finely granular content.

Langdon & Fullerton (1975, 1977) clearly demonstrated that there is an essential difference between the sporogenesis of *Macalpinomyces eriachnes* and that of "*Sorosporium*" (= *Sporisorium*) species of grasses. In *M. eriachnes* the walls of the sporogenous hyphae gelatinise and in this gelatinous mass the spores develop. In *Sporisorium* species, checked by the authors, the sporogenous hyphae are in dense coils producing spore balls.

Species of *Macalpinomyces* differ from those of *Ustilago* especially by the presence of sterile cells between the spores in *Macalpinomyces*. Superficially, *Macalpinomyces* resembles *Sporisorium* in having groups of sterile cells between the spores, groups of spores which can be mistaken for spore balls, and *Ustilago*-type of spore germination. However, the irregular groups of spores of *Macalpinomyces* must not be confused with true (though often ephemeral) spore balls in *Sporisorium* which are produced by grouped, coiled sporogenous hyphae.



Figs. 11–14. Sorus structure, spores and sterile cells of *Macalpinomyces zonotriches* K. Vánky (type).

Figs. 11, 12. Transverse section through the basal part of a young sorus showing the thick layer of surrounding, hypertrophied host tissue intermixed with intra- and extracellular hyphae, and the central mass of sporogenous hyphae in which single spores of different grade of maturity and a few giant sterile cells can bee seen. No coils of sporogenous hyphae are present, which are typical for *Sporisorium*. Bars = 100 and 10 µm, respectively.

Figs. 13, 14. Spores and sterile cells in LM and in SEM. Groups of agglutinated spores, seen in LM, can be mistaken for spore balls of *Sporisorium*. The giant sterile cell in SEM picture shows impressions of spore ornamentations. Bars = 10 µm.

A rather good character of the species of *Macalpinomyces*, beside of the lack of columella and presence of sterile cells between the spores, are the uniformly ornamented polyangular or subpolyangular spores produced in the ovaries of Gramineae. Polyangular spores do occur also in several *Sporisorium* species but there they usually are restricted to the centre of the spore balls and are more finely ornamented than the spores from the surface of the balls. Regarding spore germination, one should keep in mind that "*Ustilago*-type" of germination is a general notion comprising a great variability of different patterns of phragmobasidia. Phragmobasidia do occur in smuts belonging to many different genera. *Endosporisorium* K. Vánky (1995a:226, 1995b:212-213), with its four known species, is characterised by considerably hypertrophied sori in the stems, rarely in flowers of Gramineae in which the spore balls, spores and sterile cells are formed. Columella and fungal peridium are lacking.

Because of its emendation, the characterisation of the genus *Macalpinomyces* came closer to that of *Endosporisorium*. Further studies may show that it will be more reasonable to extend the description of *Macalpinomyces* so that it includes also *Endopsorisorum* instead of recognising several small genera with intermediate species. Knowledge of the morphology of young sori, spore and spore ball (?) formation will be decisive in this procedure.

SEE ERRATA

Key to the known species of *Macalpinomyces*.

1. Sterile cells up to 32 µm long, thick-walled (up to 5 µm) 2
– Sterile cells less than 18 µm long, thin-walled (0.5–1 µm)..............................3
2. Spores 10–19 µm long. On *Eriachne* .... *M. eriachnes*
– Spores 5–9 µm long. On *Zonotriche* .... *M. zonotriches*
3. Sterile cells 5–9.5 µm long. On *Eragrostiella* .... *M. eragrostiellae*
– Sterile cells larger..4
4. Sterile cells 8–10(–14) µm long. On *Tripogon* .... *M. tripogonis*
– Sterile cells 11–17 µm long. On *Panicum* and *Setaria* .... *M. sharmae*

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IODOWYNNEA, A NEW GENUS OF THE PEZIZALES KNOWN FROM AFRICA AND TROPICAL AMERICA*

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ABSTRACT

A new genus, *Iodowynnea* (Ascomycotina, Pezizaceae), and a new combination, *I. auriformis*, is proposed for a species previously reported from Madagascar, Trinidad, and Venezuela as *Galactinia auriformis* and *Peziza taeniospora*. It resembles *Wynnea* (Sarcoscyphaceae) in having auriculate to otideoid ascomata arising from a hypogeous stipe, besides its ribbed ascospores, but has iodine positive asci and cyanophilic ascospore warts. An extension of the range of the species is reported here to include Mexico and Dominica.

The Pezizales from Mexico are as yet poorly known. García-Romero *et al.* (1970) and Chacón and Guzmán (1983) presented a checklist of the Ascomycotina from Mexico, of which 77 species are referred to the Pezizales. Other reports (Frutis and Guzmán, 1983; Martínez-Alfaro *et al.*, 1983; Pérez-Silva *et al.*, 1985; Chacón and Guzmán, 1985; Bautista *et al.*, 1986; Medel and Chacón, 1988; Chacón and Bautista, 1988; Chacón and Medel, 1990, 1992; Pompa-González and Cifuentes, 1991, and Esqueda-Valle *et al.*, 1992) added 38 Pezizales, bringing the total known from Mexico to 115 species. When the authors revised what they first thought to be a species of *Wynnea* from Mexico, they observed an amyloid reaction in the asci. After a careful study of the materials they concluded that it is conspecific with *Galactinia auriformis* Pat. ex Le Gal, previously known from Madagascar, Trinidad, and Venezuela. When treated in *Peziza* this species was termed *Peziza taeniospora* Pfister (1974). The authors consider this species to be sufficiently distinct from *Wynnea*, *Peziza*, and other genera that it deserves a genus of its own, which is described here as *Iodowynnea*, and is referred to the Pezizaceae. One of us (R.P.K.) reserves judgement on whether the new taxon should be considered a subgenus of *Peziza* or merits generic rank. Microscopic characters were described from rehydrated sections mounted in 5 % aqueous KOH, in cotton blue in lactophenol, and in Melzer´s reagent. Colors of the ascomata are based on Kornerup and Wanscher (1989).

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* Contribution VII of the series **Ascomycetes poorly known from Mexico**

Iodowynnea Medel, Guzmán, et Chacón, gen. nov., Figs. 1-10.

A *Wynnea* affine differt ascis iodinos et sporae verrucosis in vittas in longitudinem porrectas confluentibus. Species typica: *Galactinia auriformis* Pat. ex Le Gal.

Iodowynnea auriformis (Pat. ex Le Gal) Medel, Guzmán, et Chacón, comb. nov.

≡ *Galactinia auriformis* Pat. ex Le Gal, Prod. Fl. Mycol. Madagascar 4: 417. 1953.

≡ *Peziza taeniospora* Pfister, J. Agric. Univ. Puerto Rico 58: 366. 1974 (non *P. auriformis* Schwein., Syn. Fung. Carol. Super., p. 116. 1822).

Compound **ascomata** 20-120 mm diam. and 30-90 mm high, including the hypogeous stipe. Individual **apothecia** 10-40 mm diam., cupulate, auriculate, to otideoid, caespitose in subsparassoid clumps arising from a hypogeous stipe, laterally split from apex to base, margin crenate, externally smooth, becoming finely verrucose, greyish red (8B5-8C5) with dull red tones (10B4) when fresh, blackening when touched to reddish brown (8F7-8F8), greyish brown (8F3) to indigo blue (18F3) when dry; hymenial surface smooth, reddish brown (8F8) to dark brown (7F4) to indigo blue (18F3), subcartilaginous to subcoriaceous, cracked when dry. **Stipe** 20-40 x 10-20 mm, hypogeous, subcartilaginous to tough when dry, solid to chambered, sometimes including soil particles, whitish to greyish orange (5B3) or Sahara (6C5), pale yellow (3A3) or butter

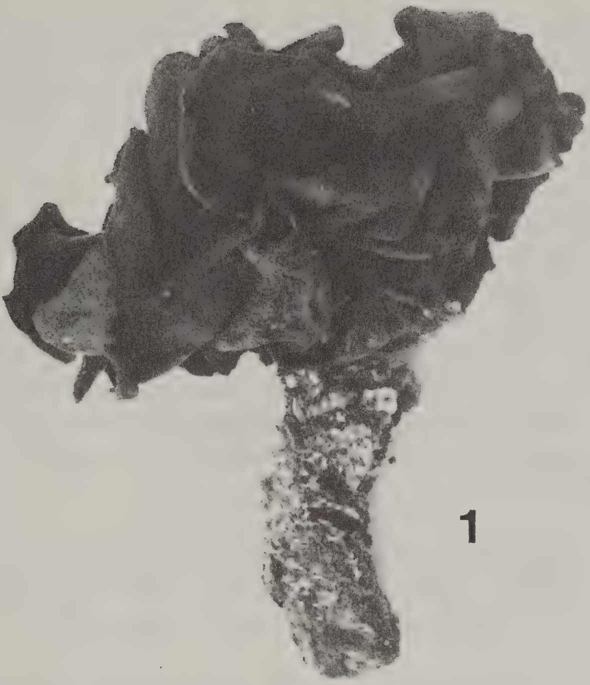


Fig. 1. Ascomata of *Iodowynnea auriformis,* **Ramón-Farias, s.n.**, photograph of dried material, natural size (note the hypogeous stipe).

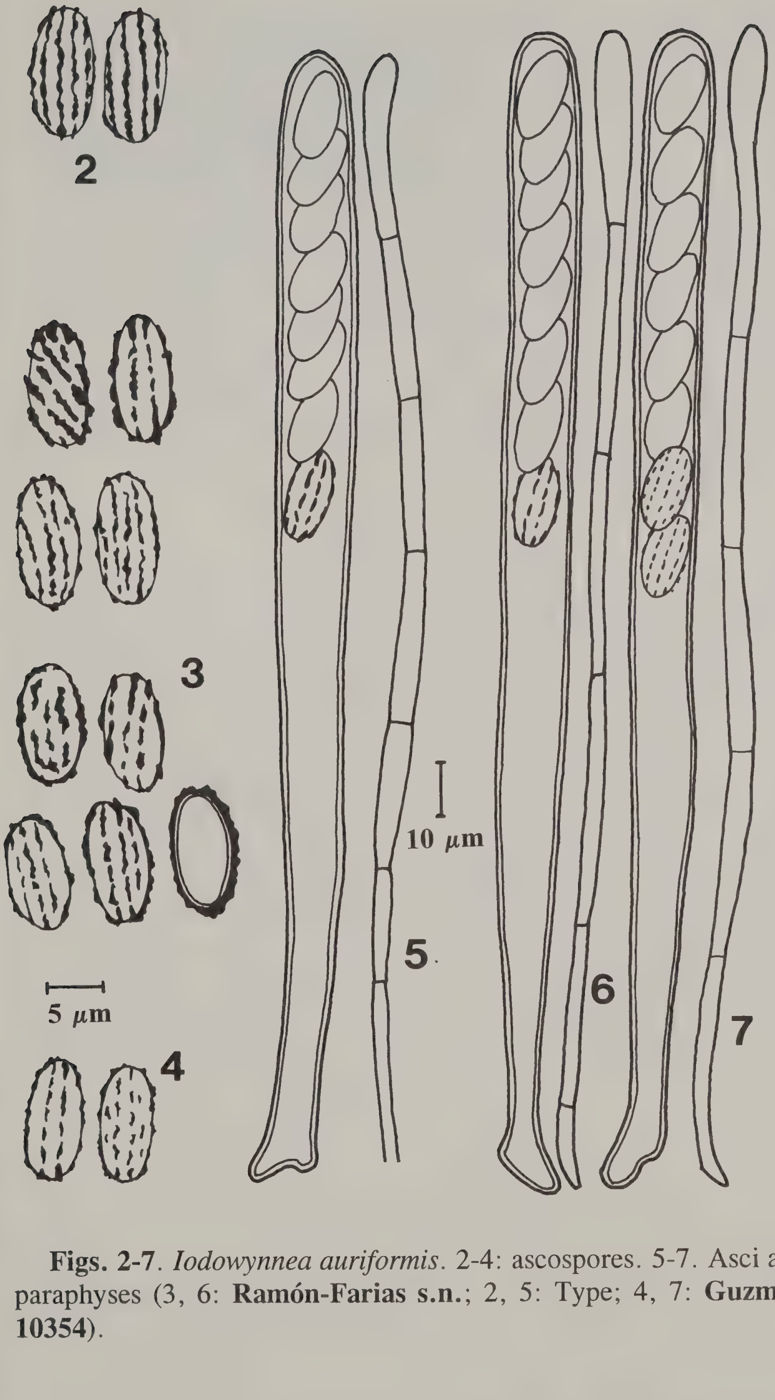
yellow (4A5), or teak brown (6F5). Context teak brown (6F5), cream (4A3), maize yellow (4A6), or light yellow (4A4) when dry. **Excipulum** 720-880 μm thick, globose to subglobose elements 10-56 x (4.8-) 10-44 μm, with intermixed hyphae 8-25 μm wide; elements of the surface 10-48 x 5.6-16 μm, arranged in short chains. The medulla of the stipe consists of hyaline or light yellow, globose to subglobose elements 4-16 μm diam, with intermixed hyphae 7-12 μm wide, with thin to somewhat thickened walls up to 1.6 μm thick. **Asci** 176-250 x 8-14 μm, operculate, walls up to 1.5 μm thick, 8-spored, cylindric, gradually attenuated towards the base, with an irregularly deformed base resulting from crozier formation, staining blue in iodine solution from apex to base, more intensely apically. **Ascospores** (10.4-) 11.2-12.8 (-13.6) x (4.5-) 5.4-6.4 (-7.2) μm, uniseriate, elliptical, hyaline, inamyloid, containing one or two, rarely several, guttules, with cyanophilic coarse warts or striae arranged in longitudinal or somewhat irregular bands. **Paraphyses** 2.4-4 μm wide, hyaline, simple, septate, tips subclavate to somewhat subglobose.

Habitat. Solitary or gregarious on soil or vegetable debris, in subtropical or tropical forests; known in Mexico in subtropical forests of mesophilic type with *Liquidambar*, *Quercus*, *Carpinus*, *Prunus*, and other trees, at 900-1000 m elevation, and in Dominica at about 450 m elevation.

Material examined. MEXICO, State of Veracruz, Cordoba region, Municipio Amatlán de los Reyes, road from Peñuela to Amatlán, near Facultad de Biología of the University of Veracruz at Cordoba, 9-VII-1986, **Ramón-Farias**, s.n. (XAL, CUP-ME 566). Region of Los Tuxtlas, Volcano San Martin, E of Cerro Vaxin, 11-VII-1972, **Guzmán 10354** (ENCB, XAL, CUP-ME 567); **Herrera & Trappe** s.n. (MEXU 9190, CUP-ME 570). DOMINICA, Cochrane Estate, above Roseau, 28-VI-1970, **Korf**, **Benson**, **Dixon**, **Pfister**, **Rossman** & **Skog** s.n. (CUP-DO 260). VENEZUELA, VI-1924, **Grisol 228** (PC, holotype of *Galactinia auriformis* Pat. ex Le Gal).

Distribution. Old World and new World tropics. It is known only from Madagascar (Le Gal, 1947, 1953), Trinidad and Venezuela (Dennis, 1963, 1970), and from Mexico and Dominica (reported here).

Discussion. The genus *Iodowynnea* is distinguished from other members of the Pezizaceae by its *Wynnea*-like habit, a well-developed hypogeous stipe, and longitudinally verrucose-striate ascospores. The names used for the species have unfortunately been confused. Patouillard applied the name "*Peziza* (sensu lato) *auriformis* n. sp." to a herbarium specimen, but never formally described it. Le Gal (1947) illustrated the spores of this species, presumably from a Madagascar specimen, calling it *Galactinia taeniospora* Le Gal, but also failed to provide a description. Later Le Gal (1953) considered her material from Madagascar and Patouillard's species from Venezuela to be conspecific, and to belong in *Galactinia*, and provided French and Latin descriptions as *Galactinia auriformis* Pat. ex Le Gal, the first valid name for this fungus. Pfister (1974) concluded along with many other taxonomists that *Galactinia* can not be separated from *Peziza*, but was unable to transfer Le Gal's name because of an earlier homonym. He thus proposed the name *Peziza taeniospora* Pfister for it, adopting Le Gal's originally invalidly published epithet. Seaver (1942) reported this species from Trinidad as *Peziza badia* Pers., but the identification was later corrected by Dennis (1963) to "*Galactinia auriformis* (Pat.)" and then to "*G. auriformis* Pat." (Dennis 1970). We consider important to mention that neither drawings nor descriptions


2
3
4
5 μm
5
10 μm
6
7

Figs. 2-7. *Iodowynnea auriformis*. 2-4: ascospores. 5-7. Asci and paraphyses (3, 6: **Ramón-Farias s.n.**; 2, 5: Type; 4, 7: **Guzmán 10354**).

before those presented here show or discuss the hypogeous stipe. Le Gal (1953) described the excipulum with globose elements (16-) 32-64 x (25-) 40-80 μm, with intermixed hyphae 16-25 μm wide, and elements of the surface 8-25 x 8-18 μm. Ascospores of the collection from Dominica were shot onto water agar but failed to germinate within 8 days (notes by Korf in herbarium packet). *Peziza retiderma* Cooke [≡ *Aleurina retiderma* (Cooke) Seaver, ≡ *Galactinia retiderma* (Cooke) Le Gal] is a close species according to Le Gal (1953), but differs in the non-stipitate ascomata, and the non-striate ascospores that turn brown at maturity (Seaver, 1914; Le Gal, 1953). The distribution of *Iodowynnea auriformis* offers another good example of the mycobiotic relationships between tropical Africa and the Neotropics, recalling those agarics discussed by Guzmán (1974) in *Fistulinella*, by Guzmán (1983) in *Marasmius jalapensis* Murr., and by Guzmán *et al*. (1989) in *Rugosospora*, which all grow in tropical Africa and the Neotropics.

Acknowledgments

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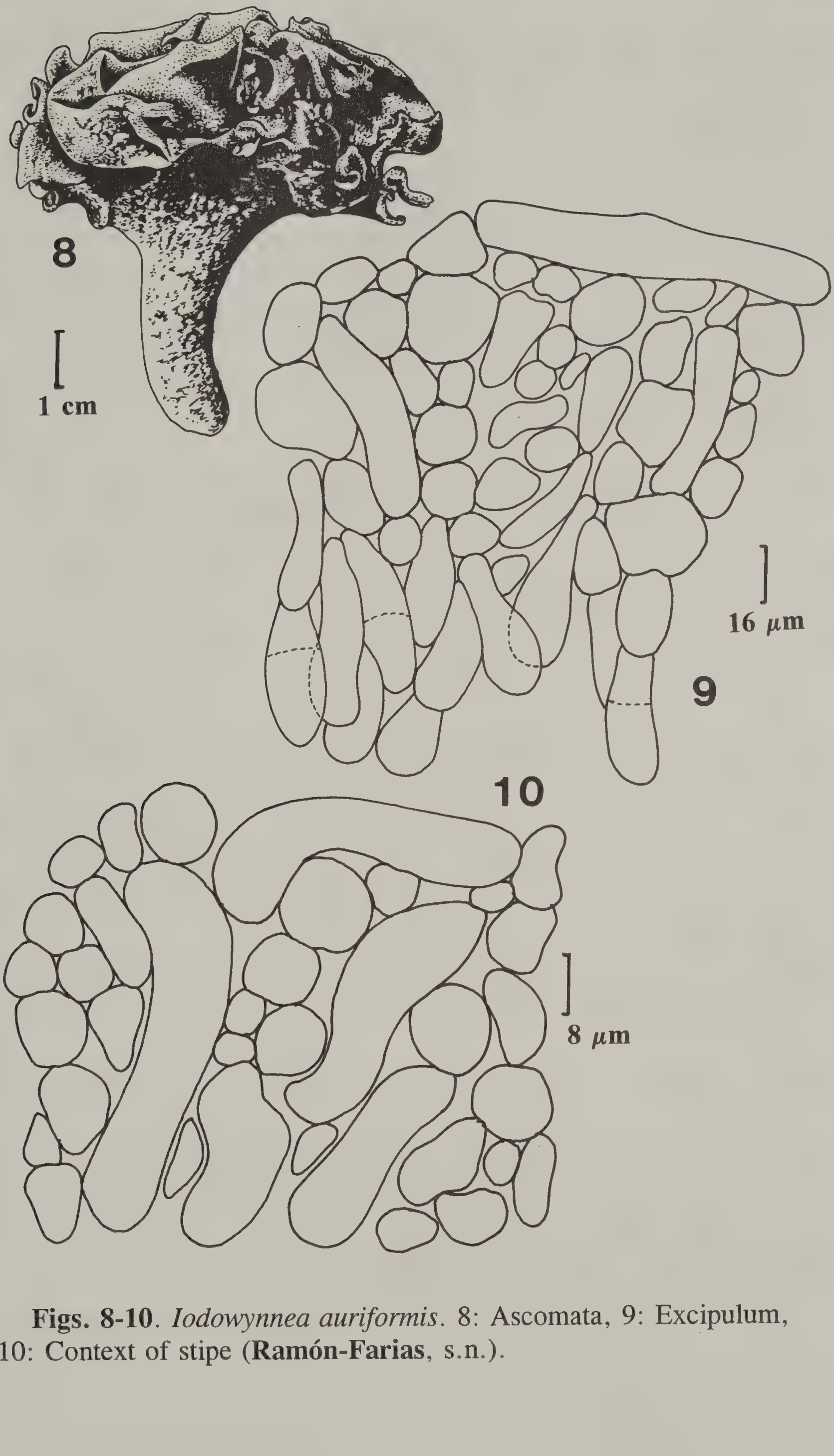
8
1 cm
16 μm
9
10
8 μm

Figs. 8-10. *Iodowynnea auriformis*. 8: Ascomata, 9: Excipulum, 10: Context of stipe (**Ramón-Farias**, s.n.).

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MYCOTAXON

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HYPHOMYCETES (DEUTEROMYCETES) IN CONES OF ARAUCARIA MIRABILIS (SPEGAZZINI) WINDHAUSEN, MIDDLE JURASSIC OF PATAGONIA, ARGENTINA.

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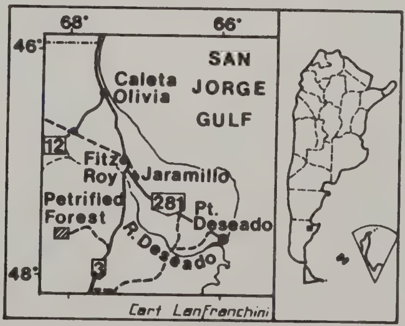
ABSTRACT

A new genus and species of *Hyphomycetes* (*Dematiaceae*), *Palaeopericonia fritzschei*, is described and illustrated from cones of *Araucaria mirabilis* (Spegazzini), collected from the La Matilde Formation (Middle Jurassic) Santa Cruz Province, Argentina.

KEYWORDS: Hyphomycetes, Dematiaceae, *Palaeopericonia*, *Araucaria*, Middle Jurassic, Jaramillo Petrified Forest.

Upon performing anatomical analysis of young cones belonging to *Araucaria mirabilis* (Spegazzini) Windhausen, from the Jaramillo Petrified Forest, La Matilde Formation (Middle Jurassic), Santa Cruz Province, Argentina (fig.1), much of the unlignified tissues were replaced by hyphal mycelium, and fungal spores.


68°
66°
46°
48°
SAN JORGE GULF
Caleta Olivia
12
Fitz Roy
Jaramillo
Petrified Forest
281
Pt. Deseado
R. Deseado
3
Cart Lanfranchini

1

Fig.1. Map of locality.

The sample in question became fossilized as a siliceous permineralization, with good preservation. Serial thin petrographic slides were made, both longitudinal and transverse. The micro and megascopic materials are housed at the Paleobotany Division Collection of the Faculty of Natural Science and Museum, National University of La Plata, under the acronym LPPB.

In many respects, the fossil material has structures similar to the saprophytic members of the extant Dematiaceae.

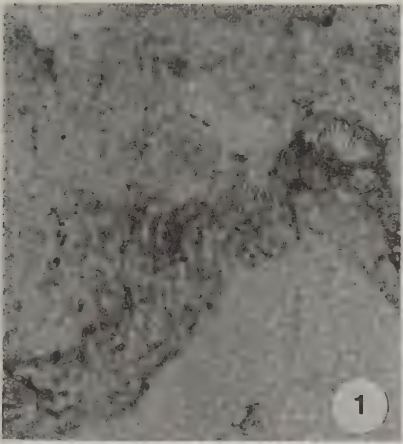
Palaeopericonia fritzschei Ibáñez et Zamuner gen. & sp.nov.
Plate I, Figs. 1-6; Fig. 4

Mycelium immersum, ex hyphis septatis, brunneis, verrucosus, 4.3-9.6 m in diam. Conidiophora micronemata, mononemata. Cellulae conidiogenae terminales et blasticae. Conidia sphaeria, verrucosa, brunnea, solitaria vel brevicatenis basipetas, 6.7-14.4 m diam. Chlamydosporae in substrato immersae, globosa, brunnea, solitaria.
Holotypus: ARGENTINA, Santa Cruz, Bosque Petrificado Jaramillo, Formatio La Matilde (Jurasicus Medius), Leg. K. Fritzsche, in conus Araucaria mirabilis, LPPB.12614; LPPm.1353-1356

Etymology: *Palaeo* (from Greek *Palaios* = old) and Periconia (due to its similarity with the extant genus). This species is dedicated to Mr. Kurt Fritzsche, who donated the material studied and is an enthusiastic amateur student of Patagonian fossils.

Mycelium immersed, organized in layers (Pl. I, 1,2); composed of brown hyphae, 4.3-9,6 µm wide, septa being infrequent, thin and delicate walls with sparse rounded ornamentations (Pl. I,6). Conidiophores micronematous, mononematous. Coniodogenous cells blastic, terminal, with a blistered end. Blastoconidia globose, brown or dark brown, verrucose-walled (Pl.I, 3), 6.7-14.4.µm, formed singly or in basipetal chains of up to 9 elements (Pl. I, 2-5), from compact apical heads. Spherical terminal chlamydospore, 37.4 x 41.3 µm, with a thick wall 2.4-3.4 µm wide, with contracted content, with a supporting hyphal end 8.2 µm in diametre (Pl. I,6).
Habit: growing in cortical and nucellar parenchymatous tissues (Pl. I, 3,4) at the apical zone (Pl. I, 1,2) or around the vascular tissue (Pl. I, 5) of the cones in *Araucaria mirabilis* (Spegazzini) Windhausen.

Plate I. 1. General aspect of mycelium (LPPm 1355), 100X. 2. Detail of stratified mycelium -arrow: basipetal chain of conidia (LPPm 1354), 100X. 3. Group of conidia -arrow: conidial formation with verrucose-wall, 200X. 4. Conidial formation within a conidiogenous hypha (LPPm 1355) 400X. 5. Conidial heads near vascular tissue (LPPm 1354), 100X. 6. General view of chlamydospore and detail of hyphae wall ornamentation (LPPm 1354), 100X.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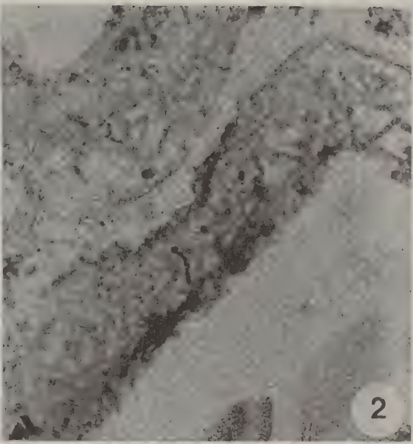
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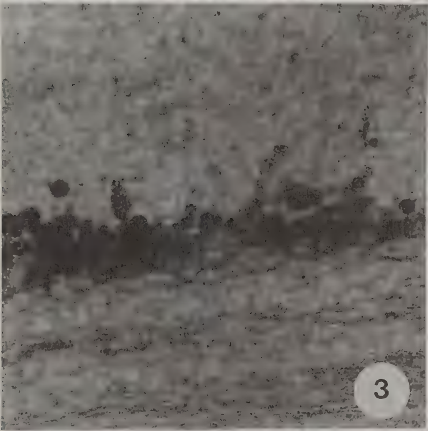
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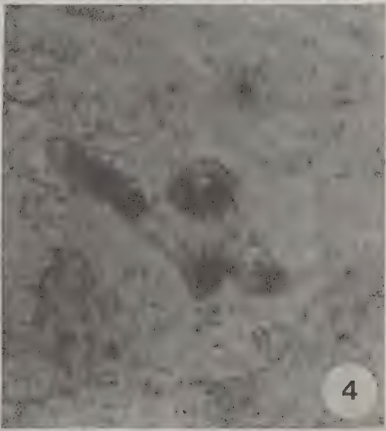
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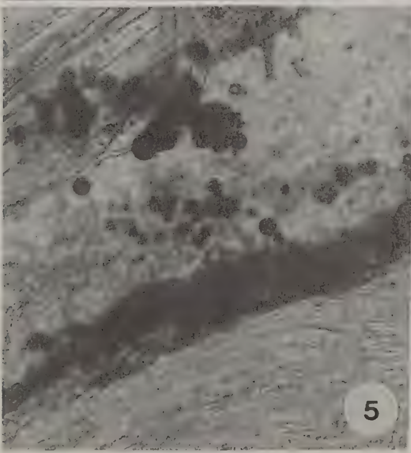
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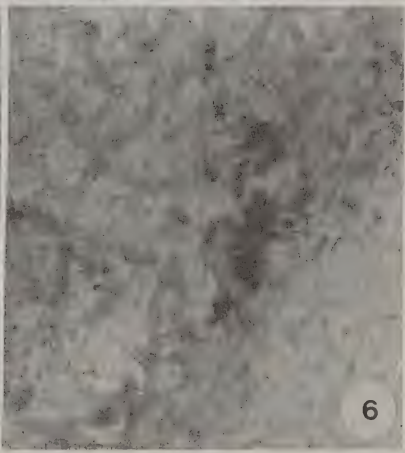
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DISCUSSION AND COMPARISONS

The material studied is made up of only asexual structures represented by conidia produced on single conidiophores, not enclosed in pycnidia or acervuli (conidiomata). This allows the assigment of this material within *Hyphomycetes* – *Moniliales*. The presence of conidia and mycelium pigmented, rough-walled and conidial chains, would relate the sample studied to different *Dematiaceae* genera. This is supported by the black colour the conidia have preserved (Pl. II, 5), that could be associated to a dark mycellium -at least when alive. The closely related genera would be *Periconia*, *Torula*, *Stachybotrys*, *Humicola*, *Thermomyces* and *Chlamydomyces*. Comparisons can be seen on Chart 1.

Almost a dozen fossil genera have been described belonging to the Dematiaceae, among them *Torulites* Pia, 1927. This genus, and therefore extant *Torula*, shows affinities with our material, though it is clearly differentiated by the usual non-spherical form of the spores, and the complex organization of its conidia in profusely branched chains.

Its affinity with *Periconia* is established by the presence of spherical, verrucose conidia, similar in size, solitary or in simple chains (Pl. II,4), as seen in the *P.laminella* and *P.macrospinosa* (figs.2, 3, and 4).

Extant Araucariaceae are invaded by members of 4 Fungal groups such as Oomycetes, Ascomycetes, Basidiomycetes and Deuteromycetes (Farr et al., 1989: 45). Within the latter, 12 Coelomycetes genera and 8 Hyphomycetes genera have been recognized, 5 of which are Dematiaceae. Most of these genera invade leaves, causing necrosis with colour changes and in only one case they invade the wood.

Periconia has not been described invading extant Araucariaceae. It is mainly a saprophyte, frequent in soil as well as on decomposing wood, leaves and stems of Angiosperms.

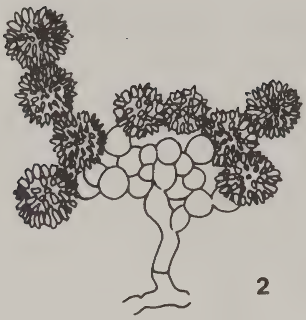
The material studied would represent the first fossil record related to *Periconia* and the oldest to date of the Dematiaceae family.

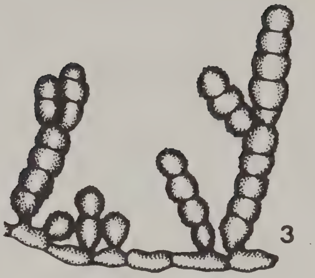
Probably, *Palaeopericonia* would represent an oportunistic saprophyte; evidence of other kinds of association has not been observed (parasitism, mutualism). The action of this saprophyte is supposed to have begun after the fall of young cones, contributing to their decomposition.

The presence of *Palaeopericonia* suggests the existence of a warm temperate and very wet habitat.

CHART 1.

SIMILAR CHARACTERS TO *PALAEOPERICONIA*	DIFFERENTIAL CHARACTERS TO *PALAEOPERICONIA*
Periconia Tode:Fr. 1821 (D.H. 1971: 345-353) - Dematiaceous, verrucose mycelium - Conidiophores sometimes rugose and solitary - Conidia spherical, verrucose, formed in compact, apical heads, in relatively short chains - Habit: on wood, leaves, stems and canes in decomposition, soil, cosmopolitan	- Conidiophores generally in small groups or fascicules sometimes ramified - Conidiogenous cell differentiated - Conidia mostly in ramified chains - On *Betula, Fagus, Ilex, Quercus, Cassia, Typha, Festuca, etc.*
Stachybotrys Corda, 1837 (Barron, 1972: 207) - Mycelium dematiaceous, rugose - Condiophore undifferentiated, verrucose, dark - Conidia dark, rugose, not septate,spherical, catenated - Chlamydospores present in some species - On soil, cellulolytic, herbaceous stems, branches of trees, occasionally on dead plants. Cosmopolitan	- Mycelium and conidia sometimes smooth - Presence of phialides - On *Musa, Ipomea, Avena*
Humicola Traaen, 1914 (Barron, 1972: 207) - Mycelium dark, verrucose, septate - Conidiophore undifferentiated, verrucose, dark - Conidia dark, 6-7 µm wide, sometimes in short chains - Chlamydospores usually present - On soil, wood, plant detritus. Cosmopolitan	- Conidia usually solitary, agrogenous, smooth - With phialidic state
Torula (Persoon) Link, 1809 (Ellis, 1971: 336-338) - Mycelium dematiaceous, verrucose - Conidiogenous cells, polyblastic or sometimes monoblastic, verrucose or echinulate, usually spherical - Conidia dark, verrucose or echinulate, 4-22 µm wide - On dead pericarp (*Hibiscus*), dead stems grasses, soil Cosmopolitan	- Mycelium sometimes smooth-walled - Conidia mostly in profusely branched chains
Thermomyces Tsiklinsky, 1899 - Conidiogenous cells monoblastic, terminal - Conidia dark, verrucose, spherical, terminal, 5-12 µm wide - On soil and leaf litter	- Mycelium smooth - Conidia solitary, acrogenous, anular and lobed, smooth - Thermophilic, on *Triticum* and *Zea*
Chlamydomyces Bainer, 1907 - Conidia with terminal cells, rugose, dark - Frequent on fruits and seeds (Angiosperms)	- Conidia solitary, agrogenous, 2-septate, hyaline and smooth basal cells, terminal cells 20-50 µm wide





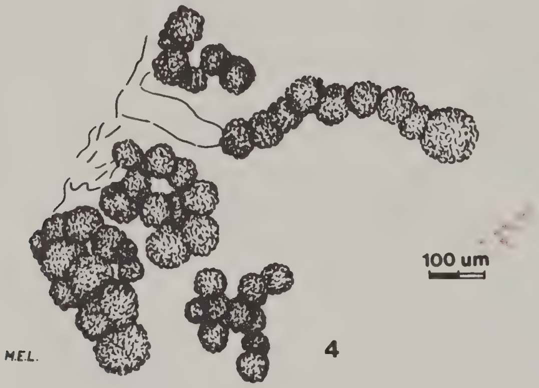


Fig.2. Conidiophore and conidia in *Periconia macrospinosa*, 500X. Redrawn of Domsch et al., 1993: 613.
Fig.3. Conidiogenous cells and conidia in *Torula herbarum*, 500X. Redrawn of Domsch et al., 1993: 785.
Fig.4. *Palaeopericonia fritzschei* gen. & sp. nov. 500X. Basipetal chains from compact apical heads.

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MYCOTAXON

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PALIPHORA INTERMEDIA SP. NOV. FROM AUSTRALIA

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Paliphora intermedia sp. nov. (Hyphomycetes) from unidentified leaf litter collected in Queensland, Australia is described and compared with the two other species in the genus.

The dematiaceous hyphomycete genus *Paliphora* was established by Sivanesan and Sutton (1985) for a fungus collected on dead *Xanthorrhoea* leaves in Australia. It is characterised by setiform conidiophores bearing integrated, intercalary, polytretic conidiogenous cells, with loci occurring immediately below the septa. Conidia in the type species, *P. aurea* Sivan. & B. Sutton, are small, hyaline, 0 (-1) septate, curved, and gradually tapered from the obtuse apex to a narrow base. A second species, *P. porosa* Kuthub., has been described from leaf litter in Malaysia (Kuthubutheen 1987). It differs from *P. aurea* in having larger conidiophores and larger cylindrical conidia which commonly are 1- septate.

A fungus collected on unidentified rain-forest leaf litter in Queensland is congeneric with the two species of *Paliphora*, and shows similarities in particular with *P. porosa*. However differences between the two taxa are sufficient to warrant the description of a new species.

Paliphora intermedia Alcorn, sp. nov. Fig. 1

Coloniae effusae, sparsae. Conidiophora macronematosa, mononematosa, solitaria, simplicia, erecta, plerumque recta, 16-22 septata, brunnea, laevia vel apicem versus verruculosa, apicem versus gradatim attenuata, ad basim tumida 10-19µm crassa, prope basim 6-7µm crassa, 135 - 205µm longa. Cellulae conidiogenae in conidiophoris incorporatae, intercalares, determinatae, mono- vel polytreticae. Conidia holoblastica, hyalina, asymmetrice 1-septata, laevia, recta vel leviter curvata, cylindrica, ad apicem obtusa, ad basim subacutata vel obconica, 14.5-19 x 2-2.2µm.
In foliis emortuis, Gwrongoorool Track, Lamington National Park, Queensland, Australia, 24 Sept. 1993, J.L. Alcorn 93/1804*d*, BRIP 22556, holotypus; IMI 361448, isotypus.
Etym: *intermedius* (L.), intermediate: conidiophore and conidium sizes between those of *P. aurea* and *P. porosa*.

Colonies effuse, sparse. *Conidiophores* macronematous, mononematous, single, erect, mostly straight, brown, thick-walled, evenly 16-22 septate, often with a swollen basal cell, smooth except for the acute apical cell which is inconspicuously roughened, gradually tapered upwards, 135-205μm long, the swollen basal cell 10-19μm diam. and the cell immediately above it 6-7μm diam. *Conidiogenous cells* integrated, intercalary, determinate, cylindrical, mostly monotretic with the pore situated just below the septum, occasionally with more than one pore. In the penultimate apical cell the pore is 2-5μm below the septum, and 1-3μm in the cell below that. *Conidia* holoblastic through pores in the conidiogenous cell wall, hyaline, mostly 1- septate, thin-walled, smooth, cylindrical or slightly fusoid, apex obtuse, base subacute or obconic, straight or slightly curved, irregularly guttulate, 14.5 - 19 x 2(-2.2)μm. The septum is placed slightly asymmetrically, resulting in apical and basal cell lengths of 6.5-9μm and 8-10.5μm, respectively, and a quotient for apical: basal cell length of ca 0.85.

Paliphora intermedia is distinguished readily from the generic type on the basis of conidiophore dimensions and conidium shape, septation and size. It is somewhat more closely allied to *P. porosa*, but can be separated by the following morphological differences, summarized in Table 1. *P. intermedia* has smaller, more closely and regularly septate conidiophores, much shorter penultimate basal cell, a swollen basal cell and region immediately above it of lesser diameter than in *P. porosa*, longer apical conidiophore cell, and shorter conidia in which the septum is commonly supra-median.

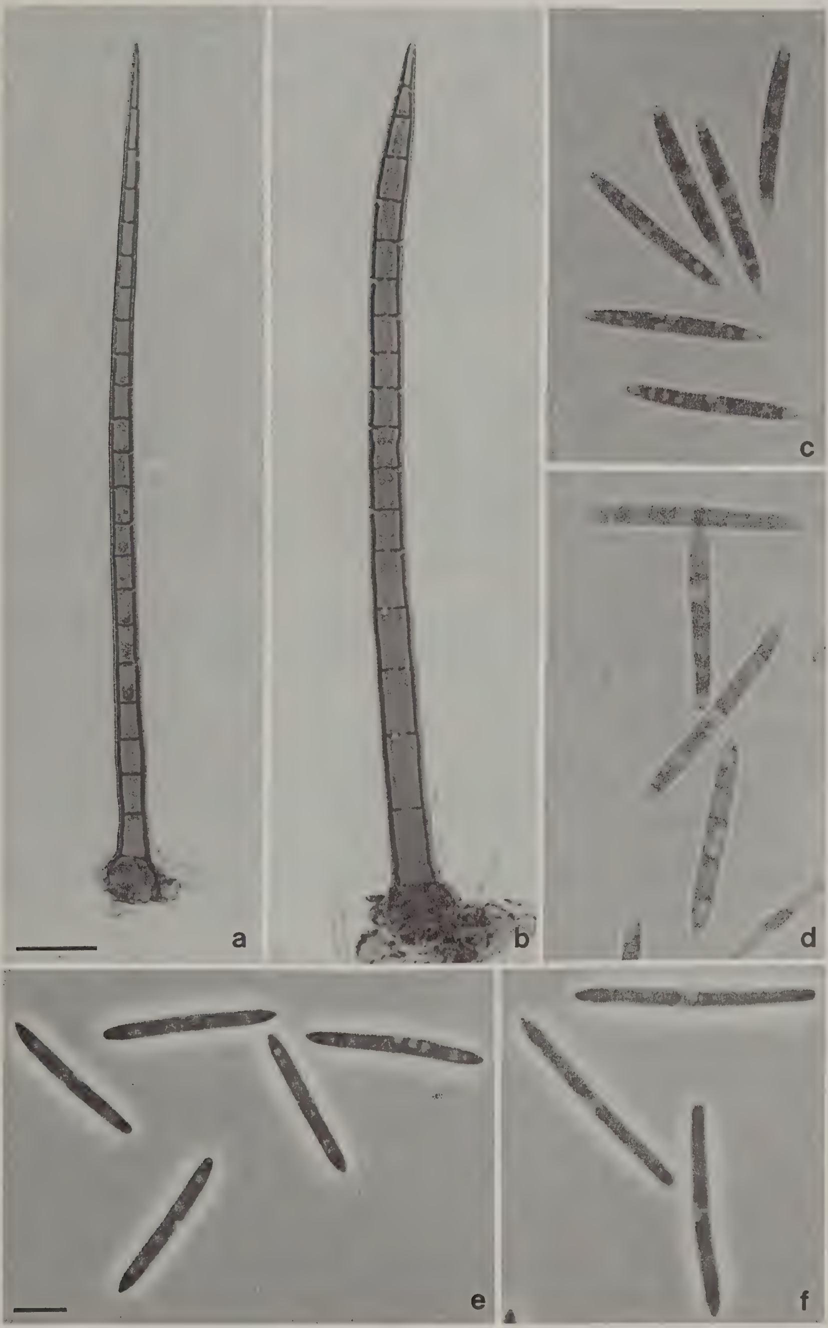
Table 1. Comparison of *Paliphora intermedia* and *P. porosa* (dimensions are in μm)

	P. intermedia	*P. porosa*[*]
Conidiophores		
length	135-205	200-360
swollen base diam.	10-19	16-30
diam. near base	6-7	9-15
basal cell length	9-14	15-30 (-38)
apical cell length	12.5-22.5	7.5-15 (-21)
septa number	16-22	15-25
mean cell length	9.3	12.8
Conidia		
length	14-19	12-25
diam.	2-2.2	1-2.5
lower cell length	8-10.5	9-12
upper cell length	6.5-9	9-11.5

(* combines personal observations and data from Kuthubutheen 1987)

Paliphora aurea has been recorded from India and New Caledonia by Vasant Rao and de Hoog (1986) and Mouchacca (1990) respectively, and these records merit discussion. Voucher specimens for both have been examined, and are indistinguishable from the

Fig. 1. *Paliphora intermedia* (BRIP 22556) and *P. porosa* (IMI 312056). Conidiophores of *P. intermedia* (a) and *P. porosa* (b). Conidia of *P. intermedia* (c,e) and *P. porosa* (d, f). Scale bars = 20 μm (conidiophores), 5 μm (conidia).


a
b
c
d
e
f

collection described above as *P. intermedia.* Kirk (pers. comm. cited by Vasant Rao & de Hoog, 1986) considers the type specimen of *P. aurea* to be depauperate, and that the normal condition of conidia is 1-septate. I have examined holotype material (IMI 263424*g*) and another portion of the same collection (IMI 263424*l*) without finding *Paliphora* conidiomata, and therefore have been unable to confirm these observations. Until such time as additional material can be collected in the type locality, it seems preferable to maintain these morphologically distinct collections as separate taxa.

P. intermedia was established in culture. It grows slowly on PDA, reaching a diameter of 17-21 mm in one month. Sporulation in culture was sparse, with small, thin-walled conidiophores being formed.

Specimens examined. *Paliphora aurea*: on dead leaves of *Xanthorrhoea* sp., Tinbeerwah, Queensland, Australia, 29 Aug. 1981, B.C. Sutton & J.L. Alcorn, IMI 263424*g*, holotype. *Paliphora intermedia*: on unidentified leaf litter, Gwrongoorool Track, Lamington National Park, Queensland, Australia, 24 Sept. 1993, J.L. Alcorn 93/1804*d*, BRIP 22556, holotype, IMI 361448, isotype; on rotten leaves, Dehra Dun, Uttar Pradesh, India, July 1985, V. Rao and D.R. Kumar, CBS-H 3902; on forest litter, Mt Koghis, New Caledonia, two slides ex PC. *Paliphora porosa*: on dead leaves, Lepar Forest Reserve, Pahang, Malaysia, July 1986, A.J. Kuthubutheen, IMI 312056, holotype.

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SOME FOLIICOLOUS FUNGI FROM SOUTHERN INDIA

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ABSTRACT

Nineteen species of foliicolous fungi collected from the southern Western Ghats of Kanniyakumari and Tirunelveli districts and the Anamalai hills of Coimbatore district, Tamil Nadu are described. Of these, *Armatella kakachiana*, *Asterina acronychiae*, *A. asclepiadis*, *A. betonicae*, *A. caseariicola*, *A. elatostemae*, *A. erythropalicola*, *A. loeseneriellae*, *A. palaquii*, *Asterostomella excoecariicola*, *A. micheliae*, *Caudella gordoniae*, *Ferrarisia litseae* and *Tichasterina goniothalami* are new species, while *Asterina elaeocarpicola* Hansf., *A. pavoniae* Werd. and *A. trichiliae* Doidge are reported for the first time from India. The genus *Ferrarisia* is also reported for the first time from India.

Key words: *Armatella*, *Asterina*, *Asterostomella*, *Caudella*, *Ferrarisia*, *Trichasterina*, Southern India.

1. **Armatella kakachiana** sp. nov. (Fig. 1)

Coloniae hypophyllae, tenues, ad 5 mm diam., confluentes. Hyphae fortitier appressae in hospitis epidermatis, flexuosae vel anfractuae, irregulariter ramosae, laxe reticulatae, cellulae 34-40 x 6-8 µm. Hyphopodia alternata, antrorsa, subantrorsa vel retrorsa, 24-31 µm longa; cellula basali cylindracea vel cuneata, 9-15.5 µm longa; cellula apicali ovata, globosa, elongata, cylindracea, profunde vel tenuise lobata, recta vel curvula, 15-18.5 x 12-15.5 µm. Perithecia dispersa, verrucosa, ad 217 µm diam.; cellulae peritheciales protrudae; asci numerosi, cylindrici vel fusiformi, stipitati, quadrispori, paraphysati, 71-77.5 x 24-28 µm; ascosporae cylindraceae, constrictae ad mediatis, late rotundate ad ambi apicem, hyalina, 1-septatae et brunneae ad maturitatae, parietis laevis, cellulae superiorae producente hyphopodia et cellulae inferiorae verto pallide et collapsae.

Colonies hypophyllous, thin, up to 5 mm in diameter, confluent. Hyphae strongly appressed to the host surface, flexuous to crooked, branching irregularly, loosely reticulate, cells 34-40 x 6-8 µm. Hyphopodia alternate, antrorse, subantrorse to retrorse, 24-31 µm long; stalk cells cylindrical to cuneate, 9-15.5 µm long; head cells ovate, globose, elongated, cylindrical, deeply to shallowly lobate, straight to curved, 15-18.5 x 12-15.5 µm. Perithecia scattered, verrucose, up to 217 µm in diam.; peridial cells protruded; asci many, cylindrical to fusiform, stipitate, quadrisporous, paraphysate, 71-77.5 x 24-28 µm; ascospores cylindrical, constricted at middle, broadly rounded at both ends, hyaline, 1-septate and brown at maturity, 43-46.5 x 15-18.5 µm, smooth-walled, one cell germinates by producing hyphopodia and the other cell turns pale and collapses.

Holotype: On leaves of Apollonias arnottii Nees (Lauraceae), Kakachi Forest, Tirunelveli dist., Tamil Nadu, Feb. 20, 1994, V.B. Hosagoudar, HCIO 41605; **Paratype**: M.K. Vayal, Kanniyakumari dist., Tamil Nadu, Feb. 27, 1994, V.B. Hosagoudar, HCIO 41622.

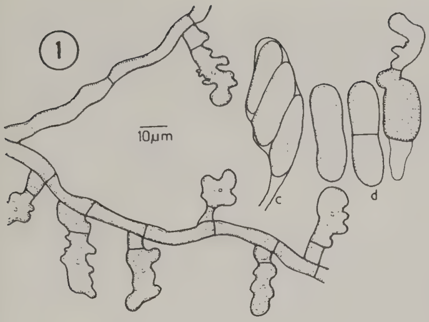
The morphology of the hyphopodia and quadrisporous asci distinguishes this species from the rest of the known Armatella species (Hosagoudar, 1991).

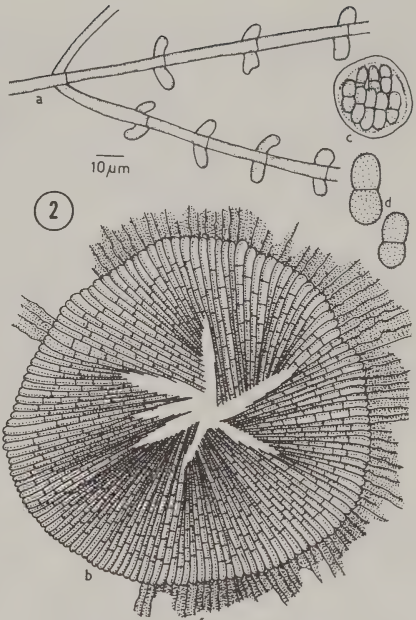
The colonies were also infected with hyperparasites, making them carbonaceous black and wooly.

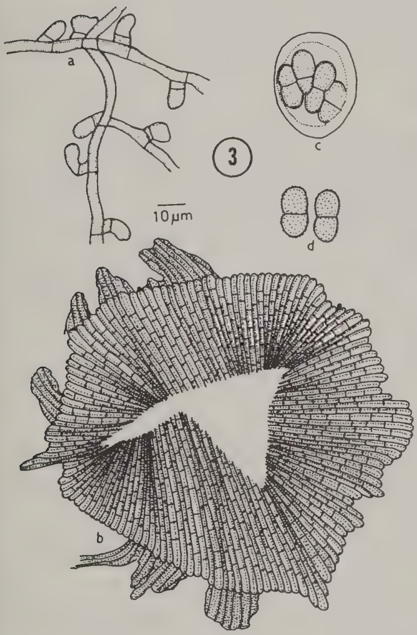
2. **Asterina acronychiae** sp. nov. (Fig. 2)

Coloniae epiphyllae, densae, crustosae, ad 2 mm diam., confluentes. Hyphae rectae opposite acuteque ramosae, laxe reticulatae, cellulae 21-25 x 3-6.5 µm. Hyphopodia plerumque opposita, raro solitaria, unicellula, ovata, longo-ovata, plerumque integra, raro angularia vel leniter lobata, 6-9.5 x 6-8 µm. Thyrothecia dense dispersa, rotunda, orbicularia, ad 136 µm diam., margine fringiora, stellato dehiscentes ad centrum; asci numerosi, globosi, octospori, 37-46.5 µm diam.; ascosporae brunneae, conglobatae, 1-septatae, profunde constrictae ad septae, 21-25 x 9-12.5 µm, cellulae inequaliae, parietis minute echinulatis.

Colonies epiphyllous, dense, crustose, up to 2 mm in diameter, confluent. Hyphae straight, branching opposite at acute angles, loosely reticulate, cells 21-25 x 3-6.5 µm.







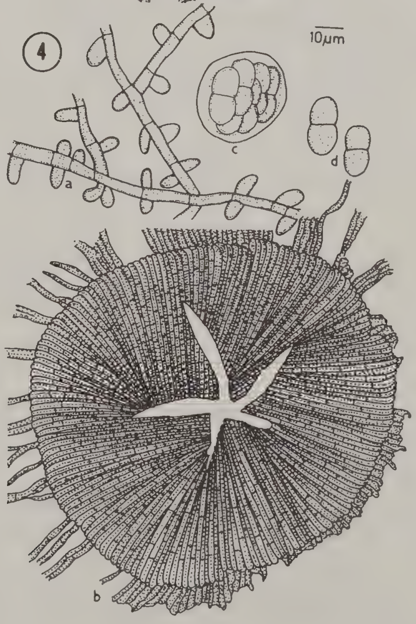


Fig. 1. *Armatella kakachiana*. Fig. 2. *Asterina acronychiae*.
Fig. 3. *Asterina asclepiadis*. Fig. 4. *Asterina betonicae*.

Hyphopodia mostly opposite, rarely solitary, unicellular, ovate, long-ovate, mostly entire, rarely angular to slightly lobate, 6-9.5 x 6-8 µm. Thyrothecia closely scattered, round, orbicular, up to 136 µm in diam., margin fringed, dehiscing stellately at the centre; asci numerous, globose, octosporous, 37-46.5 µm in diam.; ascospores brown, conglobate, 1-septate, deeply constricted at the septum, 21-25 x 9-12.5 µm, one cell slightly smaller than the other, minutely echinulate.

Holotype: On leaves of Acronychia pedunculata (L.) Miq. (Rutaceae), Kakachi Forest, Tirunelveli dist., Tamil Nadu, Feb. 21, 1994, V.B. Hosagoudar, HCIO 41628.

This species is close to Asterina vepris Doidge in having opposite hyphopodia but differs from it in having epiphyllous colonies, larger and echinulate ascospores.

3. **Asterina asclepiadis** sp. nov. (Fig. 3)

Coloniae epiphyllae, subdensae vel densae, crustosae, ad 3 mm diam., plerumque confluentes. Hyphae flexuosae, opposite vel irregulariter acuteque vel laxe ramosae, laxe vel dense reticulatae, cellulae 15-18.5 x 3-4 µm. Hyphopodia numerosa, alternata, bi-cellula, antrorsa vel retrorsa, 12-15.5 µm longa; cellula basali cylindracea, 3-9.5 µm longa; cellula apicali ovata, globosa, integra vel leniter angularia, rotunda vel truncata ad apicem, 6-9.5 x 8-10 µm. Thyrothecia dispersa, 1-2 connata, orbicularia, ad 124 µm diam., margine crenata vel fimbriata, stellato dehiscentes ad centrum; asci numerosi, globosi, 4-6 spori, 31-37.5 µm diam.; ascosporae conglobatae, brunneae, 1-septatae, profunde constrictae ad septatae, 18-22 x 6-8 µm, parietis laevis vel tuberculatis ad maturitatae.

Colonies epiphyllous, subdense to dense, crustose, up to 3 mm in diameter, mostly confluent. Hyphae flexuous, branching opposite to irregularly at acute to wide angles, loosely to closely reticulate, cells 15-18.5 x 3-4 µm. Hyphopodia numerous, alternate, 2-celled, antrorse to retrorse, 12-15.5 µm long; stalk cells cylindrical, 3-9.5 µm long; head cells ovate, globose, entire to slightly angular, rounded to truncate at the apex, 6-9.5 x 8-10 µm. Thyrothecia scattered, often 1-2 connate, orbicular, up to 124 µm in diam., margin crenate to fimbriate, dehiscing stellately at the centre; asci many, globose, 4-6 spored, 31-37.5 µm in diam.; ascospores conglobate, brown, 1-septate, deeply constricted at the septum, 18-22 x 6-8 µm, smooth-wall or tubercled at maturity.

Holotype: On leaves of Asclepias curassavica L. (Asclepiadaceae), Veerapuli Reserve Forest, Kanniyakumari dist., Tamil Nadu, Feb. 22, 1994, V.B. Hosagoudar, HCIO 41624.

Numerous and two celled hyphopodia distinguish this species from other Asterina species reported on members of the family Asclepiadaceae.

4. **Asterina betonicae** sp. nov. (Fig. 4)

Coloniae amphigenae, tenues vel subdensae, ad 2 mm diam., raro confluentes. Hyphae rectae vel subrectae, opposite vel irregulariter acuteque vel laxe ramosae, laxe reticulatae, cellulae 12-25 x 5-7 µm. Hyphopodia alternata, 30% opposita, unicellula, ovata, mammiformia, positus in crassiusculus fundamentum, sessilia, integra, 6-9.5 x 6-7 µm. Thyrothecia laxe dispersa, orbicularia, ad 220 µm diam., margine crenata vel fimbriata, hyphae fringiorae flexuosae, stellato dehiscentes ad centrum; asci numerosi, octospori, globosi, 31-35 µm diam.; ascosporae brunneae, conglobatae, 1-septatae, constrictae, 15-18.5 x 9-10 µm, parietis laevis.

Colonies epiphyllous, thin to subdense, up to 2 mm in diameter, rarely confluent. Hyphae straight to substraight, branching opposite to irregularly at acute to wide angles, loosely reticulate, cells 12-25 x 5-7 µm. Hyphopodia alternate, 30% opposite, unicellular, ovate, mammiform, seated on broad base, sessile, entire, 6-9.5 x 6-7 µm. Thyrothecia loosely scattered, orbicular, up to 220 µm in diam., margin crenate to fimbriate, fringed hyphae flexuous, dehiscing stellately at the centre; asci many, octosporous, globose, 31-35 µm in diam.; ascospores brown, conglobate, 1-septate, 15-18.5 x 9-10 µm, smooth-walled.

Holotype: On leaves of Justicia betonica L. (Acanthaceae), Kakachi Forest, Tirunelveli dist., Tamil Nadu, Feb. 25, 1994, V.B. Hosagoudar, HCIO 41556.

Alternate, opposite and entire hyphopodia distinguish this species from the other Asterina species reported on members of the family Acanthaceae.

5. **Asterina casaeriicola** sp. nov. (Fig. 5)

Coloniae epiphyllae, subdensae, ad 5 mm diam., raro confluentes. Hyphae rectae vel subrectae, alternate vel irregulariter laxe ramosae, laxe vel leniter dense reticulatae, cellulae 21-25 x 3-5 µm. Hyphopodia bicellula, alternata, unilateralia vel 5% opposita, subantrorsa vel raro retrorsa, 12-15.5 µm longa; cellula basali cylindracea, 3-6.5 µm longa; cellula apicali ovata, longo-ovata, globosa, integra vel sinuata, 9-11 x 6-7 µm. Thyrothecia dispersa, orbicularia, ad 140 µm diam., margine plerumque crenata, raro fimbriata, stellato dehiscentes ad centrum; asci numerosi, globosi vel leniter ovati, octospori, 37-40.5 µm diam.; ascosporae brunneae, 1-septatae, profunde constrictae, 18-22 x 11-13 µm, parietis laevis.

Colonies, epiphyllous, subdense, up to 5 mm in diameter, rarely confluent. Hyphae straight to substraight, branching alternately to irregularly at wide angles, loosely to slightly closely reticulate, cells 21-25 x 3-5 µm. Hyphopodia two celled, alternate, unilateral to about 5% opposite, subantrorse to rarely recurved, 12-15.5 um long; stalk cells cylindrical, 3-6.5 µm long; head cells ovate, long-ovate, globose, entire to sinuate, 9-11 x 6-7 µm. Thyrothecia scattered, orbicular, up to 140 µm in diam., margin mostly crenate, rarely fringed, dehiscing stellately at the centre; asci many, globose to slightly ovate, octosporous, 37-40.5 µm in diam.; ascospores conglobate, 1-septate, deeply constricted at the septum, lower cell slightly larger than the other, 18-22 x 11-13 µm, smooth-walled.

Holotype: On leaves of Casaeria esculenta Roxb. (Flacourtiaceae), Veerapuli Reserve Forest, Kanniyakumari dist., Tamil Nadu, Feb. 22, 1992, V.B. Hosagoudar, HCIO 41620.

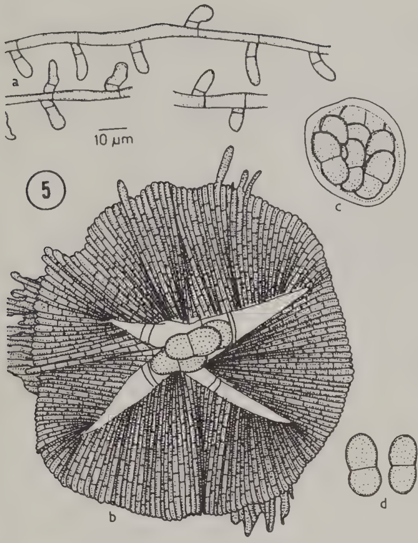
This species is close to Asterina caseariae Hansf., reported on Casearia engleri from Uganda (Hansford, 1944). However, it differs in having sinuate hyphopodial head cells in contrast to a lobate condition and the ascospore wall is smooth rather than tubercled as in A. caseariae.

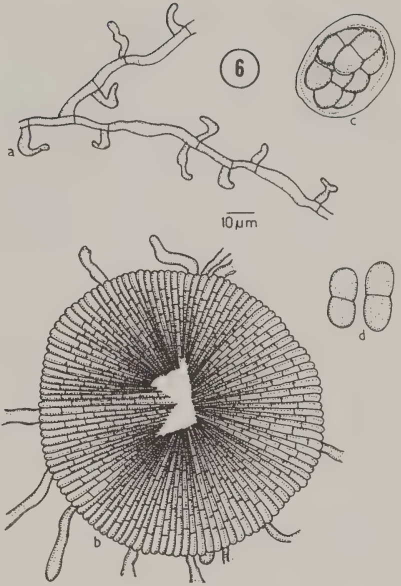
6. **Asterina elaeocarpicola** Hansf., Reinwardtia 3: 131, 1954. (Fig. 6)

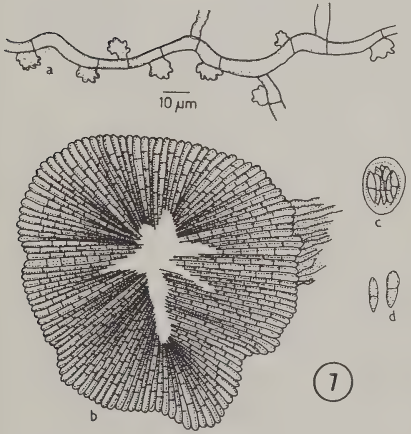
Colonies amphigenous, mostly hypophyllous, subdense, up to 3 mm in diameter, confluent and covering the entire lower surface of the leaves. Hyphae sinous to crooked, branching irregularly at acute angles, loosely reticulate, cells 15-18.5 x 3-5 µm. Hyphopodia mostly unicellular, mostly alternate, rarely opposite, cylindrical, straight, flexuous, mostly uncinate irregularly, rarely forked, 9-18.5 x 3-5 µm. Thyrothecia closely scattered and often connate, orbicular, up to 186 µm in diam., margin crenate, rarely fimbriate, dehiscing stellately at the centre; asci many, octosporous, globose, 40-43.5 µm in diam.; ascospores conglobate, brown, 1-septate, 24-28 x 9-12.5 µm, wall smooth.

On leaves of Elaeocarpus munronii (Wight) Mast (Elaeocarpaceae), Kakachi Forest, Tirunelveli dist., Tamil Nadu, Feb. 21, 1994, V.B. Hosagoudar, HCIO 41630.

This species was described by Hansford (1954) from Indonesia and is reported here for the first time from India on a hitherto unrecorded host species.







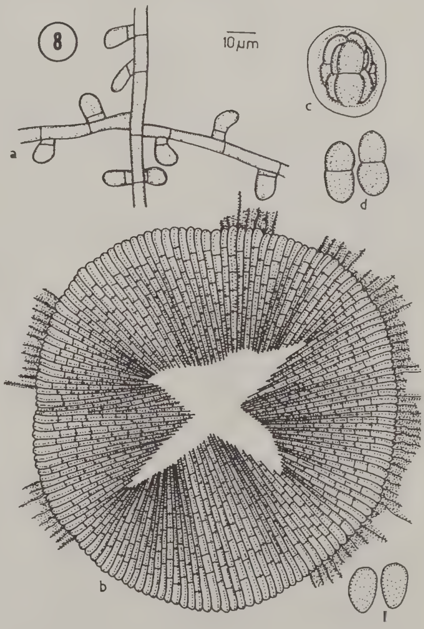


Fig. 5. *Asterina casaeriicola* Fig. 6. *Asterina elaeocarpicola*.
Fig. 7. *Asterina elatostemae*. Fig. 8. *Asterina erythropalicola*.

7. **Asterina elatostemae** sp. nov. (Fig. 7)

Coloniae epiphyllae, dispersae, minutae, densae, crustosae, ad 1 mm diam. Hyphae flexuosae, alternate vel irregulariter acuteque ramosae, laxe reticulatae, cellulae 9-25 x 3-5 µm. Hyphopodia alternata vel unilateralia, unicellula, mammiformia, non-stipitata, crenato-lobta, 6-9.5 x 9-10 µm. Thyrothecia aggregata, orbicularia, ad 124 µm diam., margine crenata vel raro fimbriata, stellato dehiscentes ad centrum; asci numerosi, globosi, octospori, 24-26 x 18-20 µm; ascosporae conglobatae, 1-septatae, brunneae ad maturitatae, 12-15.5 x 5-7 µm, parietis laevis.

Colonies epiphyllous, scattered, dense, minute, crustose, up to 1 mm in diameter. Hyphae flexuous, branching alternately to irregularly at acute angles, loosely reticulate, cells 9-25 x 3-5 µm. Hyphopodia alternate to unilateral, unicellular, mammiform, non-stipitate, crenately lobate, 6-9.5 x 9-10 µm. Thyrothecia aggregated, orbicular, up to 124 µm in diam., margin crenate to fimbriate, dehiscing stellately at the centre; asci many, globose, octosporous, 24-26 x 18-20 µm; ascospores conglobate, 1-septate, initially hyaline but turning brown at maturity, 12-15.5 x 5-7 µm, smooth-walled.

Holotype: On leaves of Elatostema lineolatum Wight (Urticaceae). Manjolai Forest, Tirunelveli dist., Tamil Nadu, Feb. 24, 1994, V.B. Hosagoudar, HCIO 41619.

Minute and dense colonies, unicellular and crenately lobate hyphopodia distinguish this species from other Asterina species reported on the members of the family Urticaceae.

8. **Asterina erythropalicola** sp. nov. (Fig. 8)

Coloniae epiphyllae, densae, crustosae, ad 2 mm diam., confluentes. Hyphae rectae vel subrectae, plerumque opposite acuteque vel laxe ramosae, laxe reticulatae, cellulae 21-28 x 6-8 µm. Hyphopodia bicellula, 30% opposita et alternata vel unilateralia, subartrorsa vel directus ad hypha, plerumque recta, 12-22 µm longa; cellula basali cylindracea, 3-9.5 µm longa; cellula apicali ovata, globosa, integra, raro truncata, 9-12.5 x 6-8 µm. Thyrothecia dense dispersa, orbicularia, ad 217 µm diam., margine plerumque fringiora, raro crenata, hyphae fringiorae flexuosae, expers hyphopodia, thyrothecia stellate dehiscentes ad centrum et peltate aperta; asci numerosi, globosi, octospori, 40-46 µm diam.; ascosporae conglobate, brunneae, 1-septatae, constrictae, cellulae unequaliae, 24-28 x 12-15.5 µm, parietis laevis. Pycnidia illis et similis thyrothecia, leniter brevior; pycnidiosporae brunneae, ovalae vel pyriformiae, 18-20 x 12-14 µm.

Colonies epiphyllous, dense, crustose, up to 2 mm in diameter, confluent. Hyphae straight to substraight, branching mostly opposite at acute to wide angles, loosely reticulate, cells 21-28 x 6-8 µm. Hyphopodia about 30% opposite, the rest either alternate or unilateral, subantrorse to perpendicular to the hyphae, mostly straight, 2-celled, 12-22 µm long; stalk cells cylindrical, 3-9.5 µm long; head cells ovate, globose, entire, rarely truncate, 9-12.5 x 6-8 µm. Thyrothecia closely scattered, orbicular, up to 217 µm diam., margin fringed, rarely crenate, fringed hyphae flexuous, without hyphopodia, thyrothecia dehiscing stellately at the centre and widely opened; asci many, globose, octosporous, 40-46 µm in diam.; ascospores conglobate, 1-septate, constricted at the septum, both cells unequal, 24-28 x 12-15.5 µm, smooth-walled. Pycnidia attached or mixed with thyrothecia, slightly smaller; pycnidiospores oval to pyriform, 18-20 x 12-14 µm.

Holotype: On leaves of _Erythropalum_ _populifolium_ (Arn.) Mast. (Erythropalaceae), Veerapuli Reserve Forest, Kanniyakumari dist., Tamil Nadu, Feb. 22, 1994, V.B. Hosagoudar, HCIO 41642.

This species differs from _Asterina_ _erythropali_ Hansf. in having epiphyllous colonies and hyphopodia with entire head cells. (Hansford, 1954).

9. **Asterina loeseneriellae** sp. nov. (Fig.9)

Coloniae amphigenae, plerumque hypophyllae, densae, velutinae, ad 5 mm diam., confluentes. Hyphae rectae vel subrectae, opposite vel irregulariter acuteque ramosae, laxe reticulatae, cellulae 15-22 x 6-8 µm. Hyphopodia opposita, alternata (20%), continua, cylindracea, ampullacea, antrorsa vel subantrorsa, plerumque recta, attenuata et rotundata ad apicem, 12-18.5 x 6-8 µm. Thyrothecia dispersa, rotunda, ad 78 µm diam., margine crenata, thyrothecia perlate aperrta et stellate dehiscentes ad centrum; asci pauci (2-4), globosi, octospori, 37-46.5 um diam.; ascosporae conglobatae, 1-septatae, profunde constrictae, hyalinae ad initio et profunde brunneae ad maturitatae, cellulae inequaliae, 30-34.5 x 15-18.5 µm, parietis glabratus. Pycnidia pauca, similis thyrothecia; pycnidiosporae fuscae, piriformiae, 18-22 x 15-18.5 µm.

Colonies amphigenous, mostly hypophyllus, dense, velvety, up to 5 mm in diameter, confluent. Hyphae straight to substraight, branching opposite to irregularly at acute angles, loosely reticulate, cells 15-22 x 6-8 µm. Hyphopodia opposite, alternate (20%), continuous, ovoid, cylindrical, ampulliform, antrorse to subantrorse, mostly straight, attenuated and rounded at the apex, 12-18.5 x 6-8 µm. Thyrothecia scattered, round, up to 78 µm in diam., margin crenate, widely opened to dehiscing stellately at the centre; asci very few (2-4), globose, octosporous, 37-46.5 µm in diam.; ascospores conglobate, 1-septate, deeply constricted at the septum, initially hyaline later turning deep brown, upper cell smaller than the lower, 30-34.5 x 15-18.5 µm, wall smooth. Pycnidia few, similar to thyrothecia; pycnidiospores dark brown, pyriform, 18-22 x 15-18.5 µm, smooth-walled.

Holotype: On leaves of Loeseneriella obtusifolia (Roxb.) A.C. Smith (Hippocrataceae), Topslip, Anamalai, Coimbatore, Tamil Nadu, March 12, 1994, V.B. Hosagoudar, HCIO 41562.

Asterina hippocrateae Ryan and A. salaciae Allesch, also occur on members of the family Hippocrataceae. The new species differs from the former in having smaller thyrothecia and larger ascospores, while it can be distinguished from the latter by having both smaller thyrothecia and smaller ascospores.

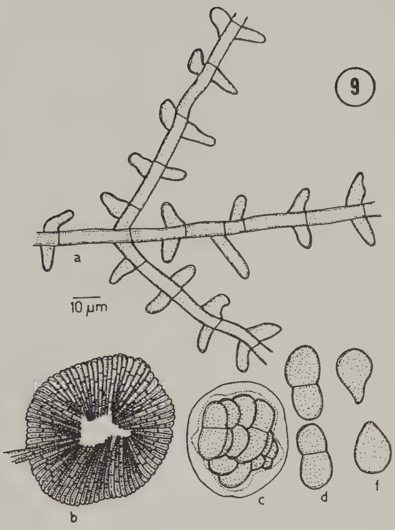
10. **Asterina palaquii** sp. nov. (Fig. 10)

Coloniae epiphyllae, densae, crustosae, ad 3 mm diam. Hyphae rectae vel subrectae, irregulariter acuteque ramosae, laxe vel dense reticulatae, cellulae 24-28 x 3-5 µm. Hyphopodia plerumque alternata, ad 20% opposita, mammiformia, positus in amplus fundamentum, integra vel raro truncata, 6-8 x 5-6 µm. Thyrothecia dispersa, orbicularia, ad 200 um diam., margine plerumque crenata, stellato dehiscentes ad centrum; asci numerosi, plerumque globosi vel leniter ovati, octospori, 46-62 x 37-46.5 µm; ascosporae conglobatae, brunneae, 1-septatae, profunde constrictae, 24-28 x 11-13 µm, parietis laevis.

Colonies epiphyllous, dense, crustose, up to 3 mm in diameter. Hyphae straight to substraight, branching irregularly at acute angles, loosely to closely reticulate, cells 24-28 x 3-5 µm. Hyphopodia mostly alternate, about 20% opposite, mammiform, seated on broad base, entire to rarely truncate, 6-8 x 5-6 µm. Thyrothecia scattered, orbicular, up to 200 um in diameter, margin mostly crenate, dehiscing stellately at the centre; asci many, mostly globose to slightly ovate, octosporous, 46-62 x 37-46.5 µm; ascospores conglobate, brown, 1-septate, deeply constricted, at the septum, 24-28 x 11-13 µm, smooth-walled.

Holotype: On leaves of Palaquium ellipticum (Dalz.) Baillon (Sapotaceae), Kudrevetti, Tirunelveli dist., Tamil Nadu, Feb. 25, 1994, V.B. Hosagoudar, HCIO 41612.

Broad based and 20% opposite hyphopodia, crenate margin of the thyrothecia and narrow ascospores distinguish this species from the similar Asterina opaca Sydow (Doidge, 1942).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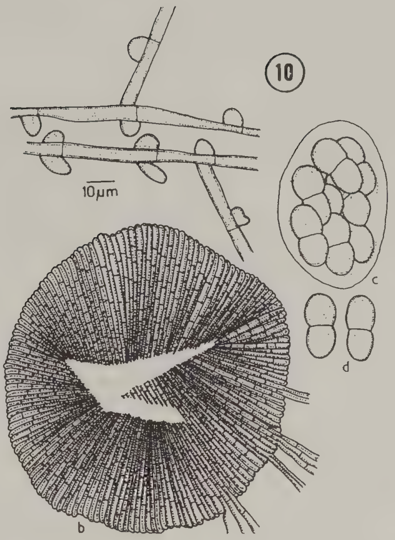

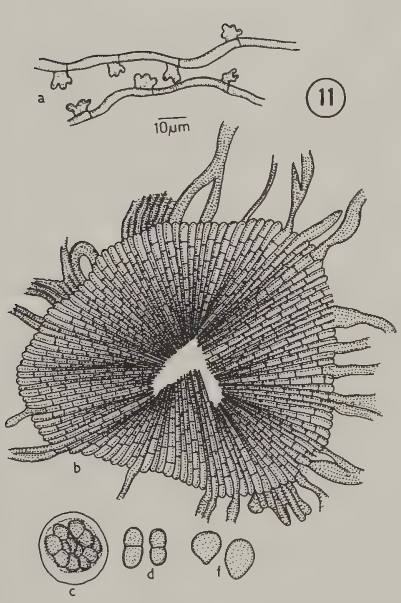
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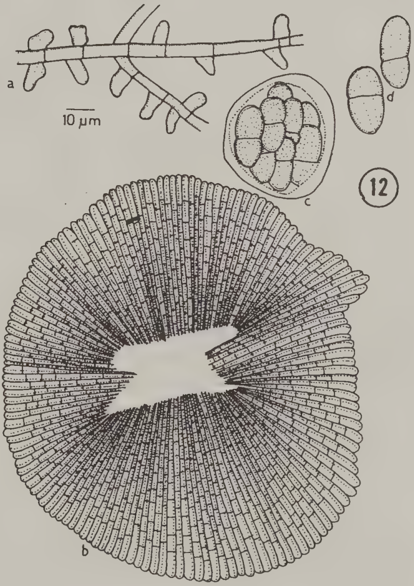
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b

Fig. 9. Asterina loeseneriellae. Fig. 10. Asterina palaquii.
Fig. 11. Asterina pavoniae. Fig. 12. Asterina trichiliae.

11. **Asterina pavoniae** Werd., Rep. spec. Nov. Reg. Veg. 19: 50, 1923. (Fig. 11)

Colonies epiphyllous, minute, subdense, crustose and covering the entire upper surface of the leaves. Hyphae flexuous, branching irregularly at acute angles, closely reticulate, cells 15-22 x 3-4 µm. Hyphopodia alternate to unilateral, sessile to slightly stipitate, unicellular, mammiform to clavate, 1-4 lobed, mostly 3-lobed, 6-9.5 x 6-10 µm. Thyrothecia scattered to connate, orbicular, up to 110 µm in diameter, margin fringed, fringed hyphae flexuous to crooked, thyrothecia dehiscing stellately at the centre; asci many, globose, octosporous, up to 35 µm in diameter; ascospores deep brown, conglobate, 1-septate, deeply constricted at the septum, 14-16 x 6-9.5 µm, both cells identical in size in some spores while the lower cell is larger in others, smooth-walled. Pycnidia many, orbicular, dehiscing stellately at the centre, up to 62 µm in diameter; pycnidiospores deep brown, obovoid to pyriform, 12-15.5 x 9-12.5 µm.

On leaves of Sida rhombifolia L. (Malvaceae), Veerapuli Reserve Forest, Kanniyakumari dist., Tamil Nadu, Feb. 22, 1994, V.B. Hosagoudar, HCIO 41626.

Werdermann (1923) described this species based on material collected on Pavonia sp. from Natal. Doidge (1942) determined the host to be Sida hislopii. This species stands distinct from the other Asterina species in having mostly 3-lobed hyphopodia. It is reported here for the first time from India, on a new host species.

12. **Asterina tertia** Racib. var. **africana** Doidge, Trans. Royal Soc. South Africa 8: 264, 1920.

On leaves of Rungia sisparensis T. And. (Acanthaceae), Kakachi Forest, Tirunelveli dist., Tamil Nadu, Feb. 23, 1994, V.B. Hosagoudar, HCIO 41625; Diotacanthus albiformis (Bedd.) Benth. (Acanthaceae), Manjolai, Tirunelveli Distr., Tamil Nadu, Feb. 24, 1994, V.B. Hasagoudar, HCIO 41555.

Asterina incilis Sydow has been reported on Rungia grandis from Sierra Leone (Sydow, 1937). However, the present collection matches well with the species to which it has been assigned.

13. **Asterina travancorensis** Sydow & Sydow, Ann, Mycol. 13: 38, 1915.

On leaves of Wattakaka volubilis (L.f.) Stapf. (Asclepiadaceae), Veerapuli Reserve Forest, Kanniyakumari dist., Tamil Nadu, Feb. 22, 1994, V.B. Hosagoudar, HCIO 41627.

14. **Asterina trichiliae** Doidge, Trans. Royal Soc. South Africa 8: 253, 1920. (Fig. 12)

Colonies epiphyllous, thin, up to 2 mm in diameter, confluent and covering the entire upper surface of the leaves. Hyphae straight, branching opposite to irregularly at acute angles, loosely reticulate, cells 15-18.5 x 3-6.5 µm. Hyphopodia opposite, subopposite, alternate and solitary, conoid, ovate, ampulliform, unicellular, entire, angular to rarely slightly lobate, 6-9.5 x 6-8 µm. Thyrothecia loosely grouped, orbicular, up to 140 µm in diameter, margin dentate to fringed, fringed hyphae tortuous, elongated and devoid of hyphopodia, such hyphae also emerge from the mycelia, thyrothecia dehiscing stellately at the centre; asci many, globose, eight spored, 40-46.5 µm in diam.; ascospores conglobate, brown, 1-septate, deeply constricted at septum, both cells unequal, 27-31 x 15-18.5 µm, smooth-walled.

On leaves of Trichilia connaroides (Wight & Arn.) Bent. (Meliaceae), Kakachi Forest, Tirunelveli dist., Tamil Nadu, Feb. 21, 1994, V.B. Hosagoudar, HCIO 41609.

This species was originally described from South Africa (Doidge, 1942) and is reported here for the first time from India on a new host.

15. **Asterostomella excoecariicola** sp. Nov. (Fig. 13)

Coloniae hyphophyllae, tenues, patentiae, ad 10 mm diam. Hyphae pallide brunneae, flexuosae vel anfractuae, profusum ramosae, laxe reticulatae, cellula 18-25 x 2-3 µm. Hyphopodia pauca, dispersa, bi vel multi-cellula, stipitata, 6-40 µm longa; stipes uni vel multicellula, recta, flexuosa vel anfractua, 6-25 µm longa; cellula apicali ovata, globosa, integra vel profunde et irregulariter lobata, 6-12.5 x 6-9.5 µm. Pycnidia dispersa, orbicularia, ad 85 µm diam., margine fimbriata, hyphae fringiorae anfractuae, stellate dehiscentes ad centrum; pycnidiosporae unicellulae, piriformiae, brunneae, 18-25 x 9-12.5 µm, parietis laevis.

Colonies hypophyllous, thin, spreading, up to 10 mm in diameter. Hyphae pale brown, flexuous to crooked, branching profuse, loosely reticulate, cells 18-25 x 2-3 µm. Hyphopodia few, scattered, two to many celled, stipitate 6-40 µm long; stalk unicellular to multicellular, straight, flexuous to crooked, 6-25 µm long; head cells ovate, globose, entire to deeply and irregularly lobate, 6-12.5 x 6-9.5 µm. Pycnidia scattered, orbicular, up to 85 µm in diameter, margin fimbriate, fringed hyphae crooked, dehiscing stellately at the centre; pycnidiospores unicellular, pyriform, brown, 18-25 x 9-12.5 µm, smooth-walled.

Holotype: On leaves of Excoecaria crenulata Wight (Euphorbiaceae), Valve House Forest, Kanniyakumari dist., Tamil Nadu, Feb. 28, 1994, V.B. Hosagoudar, HCIO 41632.

The new species differs from Asterina excoecariae Doidge in having multicellular stalked hyphopodia with lobate head cells.

16. **Asterostomella micheliae** sp. nov. (Fig. 14)

Coloniae hypophyllae, densae, ad 2 mm diam., confluentes. Hyphae rectae, irregulariter acuteque vel laxe ramosae, formatum acteque reticulatis annuli, cellulae 15-22 x 3-5 µm. Hyphopodia pauca, remote posita, unicellula, ovata, mammiformia, integra vel raro sinuata, 6-12.5 x 6-8 µm. Pycnidia dense dispersa, orbicularia, ad 80 µm diam., margine crenata, dissolutum et perlate patulus ad centrum; pycnidiosporae ovalae vel leniter clavatae, attenutae vel late rotundatae ad ambi apicem, 21-25 x 12-15.5 µm, parietis laevis.

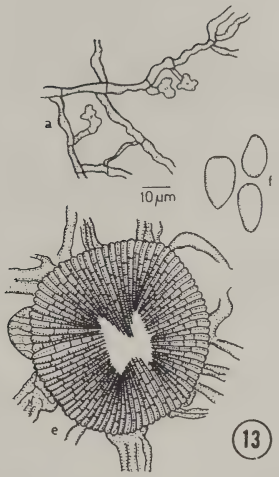
Colonies hypophyllous, dense, up to 2 mm in diameter, confluent and covering the entire lower surface of the leaves. Hyphae straight, branching irregular at acute to wide angles, forming closely reticulate rings, cells 15-22 x 3-5 µm. Hyphopodia few, distantly placed, unicellular, ovate, mammiform, entire to rarely sinuate, 6-12.5 µm. Pycnidia closely scattered, orbicular, up to 80 µm in diameter, margin crenate, dissolved and widely opened at the centre; pycnidiospores oval to slightly clavate, often attenuated to broadly rounded at both ends, 21-25 x 12-15.5 µm, smooth-walled.

Holotype: On leaves of Michelia nilagirica Zenk (Magnoliaceae), Kakachi Forest, Tirunelveli dist., Tamil Nadu, Feb. 21, 1994, V.B. Hosagoudar, HCIO 41584.

This species is close to Asterina drymidis (Lev.) Speg. but differs from it in having unicellular hyphopodia and ring-like network formation of hyphae (Stevens & Ryan, 1939).

17. **Caudella gordoniae** sp. nov. (Fig. 15)

Coloniae epiphyllae, tenues vel subdensae, plerumque confluentes. Hyphae rectae, opposite vel irregulariter laxe ramosae, laxe reticulatae, cellulae 24-46.5 x 6-7 µm. Hyphopodia alternata, unicellula, positus in amplus fundamentum, mammiformia, parietis undulata, 9-12.5 x 9-15.5 µm. Thyrothecia orbicularia, dispersa vel connata, ostiolata, superficies superior radiata, hypogenus mycelia hyphopodia, ad 186 µm diam., margine crenata; asci numerosi, ovati vel oblongi, leniter stipitati, octospori, 49-56 x



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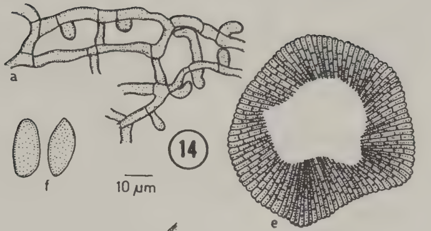

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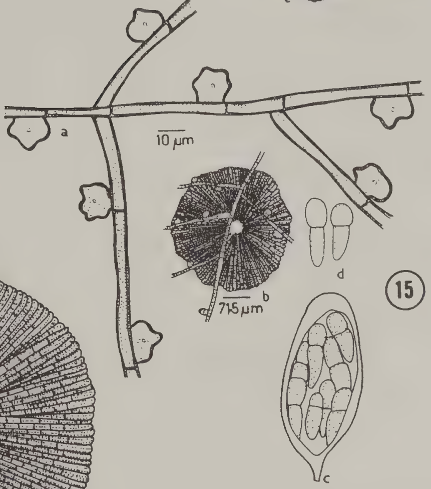
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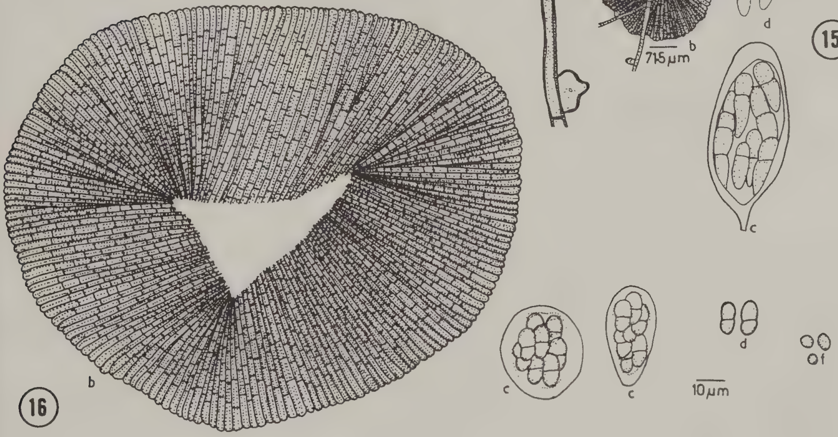

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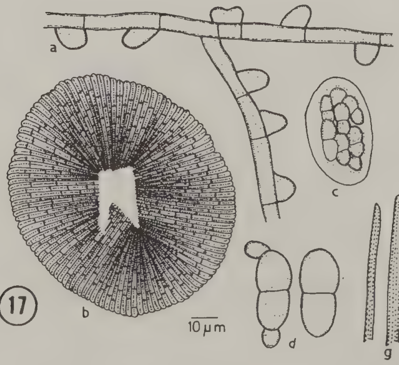
Fig. 13. Asterostomella
excoecariicola.

Fig. 14. Asterostomella
micheliae.

Fig. 15. Caudella
gordianae.

Fig. 16. Ferrarisia
litseae.

Fig. 17.Trichasterina
goniothalami.



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24-31 µm; ascosporae hyalinae, 1-septatae, 21-25 µm longae, cellulae superiorae globosae, 6-9.5 x 6-7 µm, cellulae inferiorae caudatae, 15-16 x 5-6 µm, parietis laevis.

Colonies epiphyllous, thin to subdense, widely confluent and covering the entire leaf surface. Hyphae straight, branching opposite to irregularly at wide angles, loosely reticulate, cells 24-46.5 x 6-7 µm. Hyphopodia alternate, unicellular, seated on a broad base, mammiform, margin wavy, 9-12.5 x 9-15.5 µm. Thyrothecia orbicular, scattered to connate, ostiolate, upper surface radiate, borne below the hyphopodiate mycelia, up to 186 µm in diameter, margin crenate; asci many, ovate to oblong, slightly stipitate, eight spored, 49-56 x 24-31 µm; ascospores hyaline, 1-septate, 21-25 um long; upper cell globose, ovate, 6-9.5 x 6-7 µm, lower cell caudate, 15-16 x 5-6 µm, smooth-walled.

Holotype: On leaves of Gordonia obtusa Wall. ex Wight & Arn. (Theaceae), Veerapuli Reserve Forest, Kanniyakumari dist., Tamil Nadu, Feb. 22, 1994, V.B. Hosagoudar, HCIO 41530.

This represents the first report of a Caudella species occurring on a member of the Theaceae.

18. **Ferrarisia litseae** sp. nov. Fig. 16

Coloniae epiphyllae, densae, crustosae, ad 2 mm diam., dispersae, raro confluentes. Hyphae exterior nullae. Thyrothecia evoluta in hypha nutrienta, hypha nutrienta exortus a hostes epidermalis, thyrothecia orbicularia, dimidiata, paraphysati, 18-25 x 12-15.5 µm, ad 124 µm diam., connata, collectivus dehiscentes ad centrum, margine crenata; asci numerosi, globosi ad initio, clavati ad maturitati, octospori, ascosporae conglobatae, hyalinae, 1-septatae, constrictae, 9-12.5 x 5-7 µm, parietis laevis. Pycnidia illis thyrothecia commixta; pycnidiosporae hyalinae, unicellulae, globosae vel ovatae, 5-7 x 4.5-7 µm.

Colonies epiphyllous, dense, crustose, up to 2 mm in diameter, scattered to rarely confluent. External hyphae absent. Ascomata develop on nutrient hyphae originating from the host epidermis, orbicular, dimidate, paraphysate, 18-25 x 12-15.5 µm,; up to 124 µm in diameter, connate, collectively dehiscing stellately at the centre, margin crenate; asci many, initially globose, clavate at maturity, octosporous, ascospores conglobate, hyaline, 1-septate, constricted at septum, 9-12.5 x 5-7 µm, wall smooth. Pycnidia mixed with thyrothecia; pycnidiospores hyaline, unicellular, globose to ovate, 5-7 x 4.5-7 µm.

Holotype: On leaves of Litsea glabrata (Wall. ex Nees)

Hook. f. (Lauraceae), Kakachi Cliff, Tirunelveli dist., Tamil Nadu, Feb. 25, 1994, V.B. Hosagoudar, HCIO 41613.

Absence of external mycelium and the stellately dehisence of the thyrothecia are the characteristic features of the genus Microthyriolum Sspeg. (Stevens & Ryan, 1939). Mueller & von Arx (1962) and von Arx & Mueller (1975) synonymised this genus with Ferrarisia Sacc. and recognized 4 species. Of these, Ferrarisia apiahyna (Speg.) Arx has been reported on Litsea sp. from Brazil. The new species differs from it in having smaller asci and ascospores. This is the first record of this genus from India.

19. **Trichasterina goniothalami** sp. nov. (Fig. 17)

Coloniae amphigenae, densae, velutinae, ad 10 mm diam., raro confluentes. Hyphae rectae vel subrectae, irregulariter acuteque ramosae, laxe vel dense reticulatae, cellulae 18-31 x 5-7 µm. Hyphopodia unilateralia, alternata vel ad 5% opposita, positus in amplus fundamentum, unicellula, ovata, cylindracea, mammiformia, raro truncata, 6-12.5 x 6-9.5 µm. Setae myceliales et peritheciales numerosae, simplices, rectae, erectae, obtusae ad apicem, ad 110 um longae. Thyrothecia dispersa, orbicularia, anthracina et opaqua, ad 110 µm diam., margine crenata, stellate dehiscentes ad centrum; asci numerosi, globosi vel leniter ovati, octospori, 31-40 x 27-31 µm; ascosporae brunneae, conglobatae, 1-septatae, profundae constrictae, 31-34 x 12-15.5 µm, parietis laevis.

Colonies amphigenous, dense, velvety, up to 10 mm in diameter, rarely confluent. Hyphae straight to substraight, branching irregularly at acute angles, loosely to closely reticulate, cells 18-31 x 5-7 µm. Hyphopodia unilateral, alternate and about 5% opposite, seated on a broad base, unicellular ovate, cylindrical, mammiform, rarely truncate, 6-12.5 x 6-9.5 µm. Mycelial and thyrothecial setae numerous, simple, straight, erect, obtuse at the apex, up to 110 µm long. Thyrothecia scattered, orbicular, carbonaceous black and opaque, up to 110 µm in diam., Margin crenate, dehiscing stellately at the centre; asci many, globose to slightly ovate, eight spored, 31-40 x 27-31 µm; ascospores brown, conglobate, 1-septate, deeply constricted at the septum, 31-34 x 12-15.5 µm, smooth-walled.

Holotype: On leaves of Goniothalamus wightii Hook. f & Thoms. (Annonaceae), Kudrevetti, Tirunelveli dist., Tamil Nadu, Feb. 25, 1994, V.B. Hosagoudar, HCIO 41557.

This species differs from Trichasterina polyalthiae Hansf. in having lateral hyphopodia, smaller setae and larger ascospores (Hansford, 1955).

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The letter code for all figures is as follows: a = mycelium, b = thyrotheicum, c = ascus, d = ascospores, e = pycnidium, f = conidium, g = setae.

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SOME ASTERINA SPECIES FROM SOUTHERN INDIA

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ABSTRACT

This paper gives an account of 24 Asterina species collected from Kerala and Tamil Nadu states of Southern India. Of these, Asterina anamirtae, A. balakrishnanii, A. disciferae, A. flacourtiacearum, A. goosii, A. litseae-ligustrinae, A. microtropoidis, A. oreocnidecola and A. wingfieldii are new species. A. cansjericola Hansf. & Thirum. var. indica and A. erysiphoides Kalch. & Cooke var. indica are new varieties; A. bottomleyae Doidge, A. cipadessae Yates, A. dissiliens (Sydow) Doidge, A. litseae Yates, A. tertia Rec. var. africana Doidge are reported for the first time from India. A detailed study of Asterina capparidis Sydow & Butler and A. nothopegiae Ryan is given. Asterina elaeocarpi Sydow var. ovalis Kar & Maity and A. jambolana Kar & Maity are reported for the first time from southern India. Asterina congesta Cooke is reported for the first time from the state of Tamil Nadu. Asterina granulosa (Hansf.) stat. et comb. nov. is effected here based on A. grewiae Cooke var. granulosa Hansf.

Key words: Asterina, Ascomycotina, Microthyriaceae,
southern India.

1. **Asterina anamirtae** V. B. Hosagoudar sp. nov. (Fig. 1)

Coloniae epiphyllae, tenues, ad 2 mm diam., confluentes. Hyphae pallide brunneae, subrectae vel flexuosae, alternate vel irregulariter acuteque vel laxe ramosae, laxe reticulatae, cellulae 12-15.5 x 5-6.5 µm. Hyphopodia alternata, unicellularia, pallide brunnea, globosa vel ovata, integra vel irregulariter sublobata, 9-10 x 6-6.5 µm. Thyrothecia dispersa, rotunda, 68-78 µm diam., stellato dehiscentes ad centre, laxe aperio ad lateralis, serrata vel fimbriata ad margine, hyphae fringiorae flexuosae, pallide brunneae; asci globosi, octospori, 18-22 µm diam.; ascosporae conglobatae, cinnamomeo brunneae, 1-septatae, profundae constrictae, cellulae inferiorae magniorae, 14-15.5 x 7-9.5 µm, parietis echinulatus. Pycnidia non visa.

Colonies epiphyllus, thin, up to 2 mm in diameter, widely confluent. Hyphae pale brown, substraight to flexuous, branching alternate to irregularly at acute to wide angles, loosely reticulate, cells 12-15.5 x 5-6.5 µm. Hyphopodia alternate, unicellular, pale brown, globose to ovate, entire to irregularly sublobate, 9-10 x 6-6.5 µm. Thyrothecia scattered, round, 68-78 µm in diameter, dehiscing stellately at the centre and later opened widely, margin serrate to fimbriate, fringed hyphae flexuous; asci globose, eight spored, 18-22 µm in diameter; ascospores conglobate, cinnamon brown, 1-septate, deeply constricted at the septum, one cell slightly larger, 14-15.5 x 7-9.5 µm, wall echinulate. Pycnidia not seen.

Holotype: On leaves of Anamirta cocculus (L.) Wight & Arn. (Menispermaceae), near Nirar Dam, Anamalai, Coimbatore, Tamil Nadu, March 27, 1990, V.B. Hosagoudar HCIO 30952.

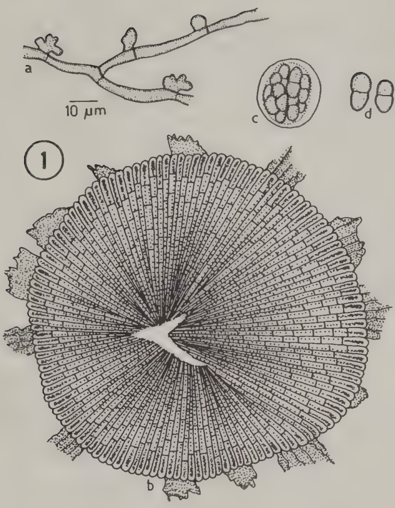
Etymology: from the host genus Anamirta.

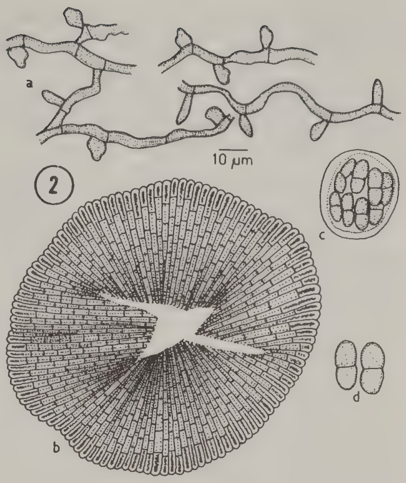
This is the first report of the genus Asterina on the members of the host family Menispermaceae (Hansford, 1944, 1946, 1949; Hansford & Thirumalachar, 1949; Stevens & Ryan, 1939).

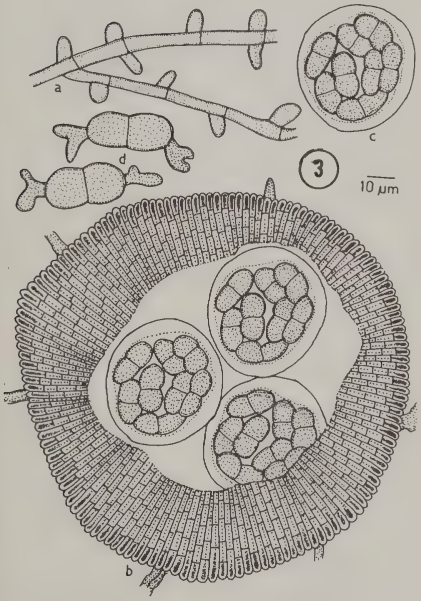
2. **Asterina balakrishnanii** V.B. Hosagoudar, sp. nov. (Fig. 2)

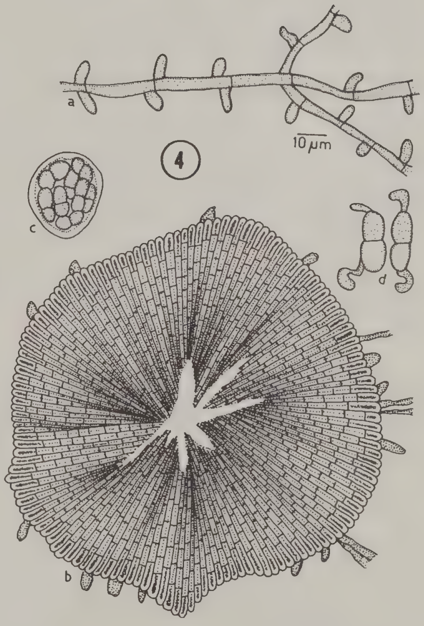
Coloniae epiphyllae, densae, crustosae, ad 2 mm diam. Hyphae fortiter appressus in hospes, anfractuae, opposite vel irregulariter acuteque ramosae, laxe reticulatae, cellulae 9-12.5 x 3-4 µm. Hyphopodia alternata, sessilia, intense brunnea, globosa vel angularia et aculeata ad apicem, 7-11 x 4-6.5 µm. Thyrothecia dense dispersa, saepe connata, rotunda vel ovata, 90-120 µm diam., stellato dehiscentes ad centre, dehiscentes extendo ad margine, margine crenata; asci numerosi, octospori, ovati vel globosi, 30-32 x 24-26 µm; ascosporae conglobatae, brunneae, 1-septatae, leniter constrictae ad septae, 18-21.5 x 9-10 µm.

Colonies epiphyllous, dense, crustose, up to 2 mm in diameter. Hyphae strongly appressed to the host, crooked, branching opposite to irregular at acute angles, loosely reticulate, cells 9-12.5 x 3-4 µm. Hyphopodia alternate, sessile, deep brown, globose and angularly pointed towards the apex, 7-11 x 4-6.5 µm. Thyrothecia closely scattered, frequently connate, orbicular to ovate, 90-120 µm in diameter, dehiscing stellately at the centre, dehiscence extended up to margin, margin crenate; asci many, eight spored, ovate to globose, 30-32 x 24-26 µm in diameter;









Abbreviations used in all figures: a = mycelium, b = thyrothecium, c = ascus, d = ascospores, e = pycnidiospores.

Fig. 1. Asterina anamirtae. Fig. 2. Asterina balakrishnanii. Fig. 3. Asterina bottomleyae. Fig. 4. Asterina cansjericola var. indica.

ascospores conglobate, brown, 1-septate, slightly constricted at the septum, 18-21.5 x 9-10 µm.

Holotype: On leaves of Solanum torvum Sw. (Solanaceae), Pamba, Idukki, Kerala, Oct. 10, 1983, V.B. Hosagoudar HCIO 30953.

Etymology: named in honor of N.P. Balakishnan.

This species is close to Asterina portoricensis Ryan reported on Solanum sp. from Porto Rico (Ryan, 1924) but differs from it in having crooked mycelia and globose to angularly pointed hyphopodia.

3. **Asterina bottomleyae** Doidge, Bothalia 4: 333, 1942. (Fig. 3)

Colonies foliicolous, amphigenous, mostly epiphyllous, thin to dense, up to 2 mm in diameter, confluent. Hyphae straight, branching opposite at acute angles, loosely reticulate, cells 12-22 x 6-8 µm. Hyphopodia alternate and opposite (ca. 50%), unicellular, conoid, broadly rounded at the apex, mostly straight and perpendicular to the bearing hyphae, 9-12.5 x 6-9.5 µm. Thyrothecia scattered to loosely grouped, often connate, circular in outline, 130-180 µm in diameter, the central portion dissolving and forming a wide opening, margin fimbriate, fringed hyphae tortuous and devoid of hyphopodia; asci globose to slightly ovate, eight spored, 31-53 µm in diameter; ascospores deep brown, conglobate, 1-septate, deeply constricted at the septum, lower cell slightly larger, 31-33 x 18-19 µm, wall smooth.

On leaves of Ilex walkeri Wight & Gard. ex Thw. (Aquifoliaceae), Kodaikanal, Madurai, Tamil Nadu, Nov. 23, 1991, K. Ravikumar HCIO 30954.

This species was reported from South Africa on Ilex mitis. It is reported here for the first time from India on a hitherto unrecorded host species (Doidge, 1942).

4. **Asterina cansjericola** Hansf. & Thirum. var. **indica** var. nov. (Fig. 4)

Differt a var. cansjericola hyphopodiis et ascosporis brevioribus.

Colonies amphigenous, predominently epiphyllous, dense, crustose, up to 3 mm in diameter, confluent. Hyphae straight, cross hyphae rarely and slightly crooked, branching opposite to irregular at acute angles, loosely reticulate, cells 12-15 x 3-5 µm. Hyphopodia predominently alternate, about 15% opposite, unicellular, ovate to cylindrical with broadly rounded apices, 9-12.5 x 6-8 µm. Thyrothecia loosely grouped, circular to ovate, 155-190 µm in diameter, dehiscing stellately at the centre, later with a wide opening, margin crenate to fimbriate, fringed hyphae straight to flexuous; asci many, globose to slightly ovate, eight spored, 30-37 x 24-31 µm; ascospores conglobate, dark brown, 1-septate, strongly constricted at the septum, lower cell slightly larger, 24-26 x 12-13 µm, wall smooth.

Holotype: On leaves of Cansjera rheedii Gmel. (Opiliaceae), Jammunarai, Kotagiri, Nilgiris, Tamil Nadu, Feb. 18, 1991, V.B. Hosagoudar HCIO 30955.

Etymology: from the host genus Cansjera, plus icola, inhabiting.

The present collection is close to Asterina cansjericola Hansf. & Thirum. in having unicellular cylindrical and entire hyphopodia (Hansford & Thirumalachar, 1948), but differs from the var. cansjericola in having smaller hyphopodia and ascospores.

This taxon was associated with Meliola sp. and Asterina cansjerae Ryan.

5. **Asterina capparidis** Sydow & Butler, Ann. Mycol. 9: 390, 1911.

Colonies foliicolous, amphigenous, dense, mostly confluent. Hyphae flexuous, branching mostly opposite at wide angles, loosely reticulate, cells 18-28 x 3-5 µm. Hyphopodia alternate, about 2% opposite, unicellular to bicellular, mostly stalked but rarely sessile, straight to often curved, 12-22 µm long; basal cells cylindrical to cuneate, 3-9.5 µm long; apical cells ovate, globose, entire, angular to sublobate, 6-12.5 x 6-9.5 µm. Thyrothecia scattered, round, 93-124 µm in diameter, dehiscing stellately at the centre, the dehisced portion often dissolved, margin crenate to fimbriate, fringed hyphae small, tortuous; asci many, globose to ovate, eight spored, 30-37.5 x 24-31 µm; ascospores brown, ellipsoidal, conglobate, 1-septate, slightly constricted at the septum, 17-18.5 x 6-7 µm, both cells mostly equal, wall smooth. Pycnidia many, like those of thyrothecia; pycnidiospores deep brown, globose to pyriform, 18-21 x 10-12 µm.

On leaves of Capparis zeylanica L. (Capparaceae), Vellingiri hills, Coimbatore, Tamil Nadu, Sept. 20, 1986, A. Diraviodoss HCIO 30956.

This species was collected by E.J. Butler in 1903 on Capparis sp. from Madras (Sydow et al. 1911). However, the hyphopodia and pycnidia were not discussed in the original description.

6. **Asterina cipadessae** Yates, Philippine J. Sci. 12: 371, 1917. (Fig. 5)

≡ Parasterina cipadessae (Yates) Mendoza, Philippine J. Sci. 49: 446, 1932.

Colonies epiphyllous, dense, up to 2 mm in diameter, confluent. Hyphae straight, flexuous to crooked, branching mostly opposite at acute angles, loosely to closely reticulate, cells 12-34 x 4-6.5 µm. Hyphopodia alternate and opposite, sessile, entire to mostly lobate, 9-12.5 x 7-9.5 µm. Thyrothecia scattered to grouped, often connate, orbicular, up to 202 µm in diameter, dehiscing stellately at the centre, margin crenate, rarely slightly fimbriate; asci many, ovate to globose, eight spored, 30-43.5 x 30-35 µm; ascospores conglobate, deep brown, 1-septate, slightly constricted at the septum, 24-28 x 12-15 µm, upper cell ovate and lower cell globose, wall smooth. Pycnidia many, similar to the thyrothecia; pycnidiospores brown, ovoid to pyriform, 12-15.5 x 4-6.5 µm.

On leaves of Cipadessa baccifera (Roth) Miq. (Meliaceae), Srimadurai, Gudalur, Nilgiris, Tamil Nadu, Jan. 25, 1990, V.B. Hosagoudar HCIO 30957.

This is the first report of this species from India.

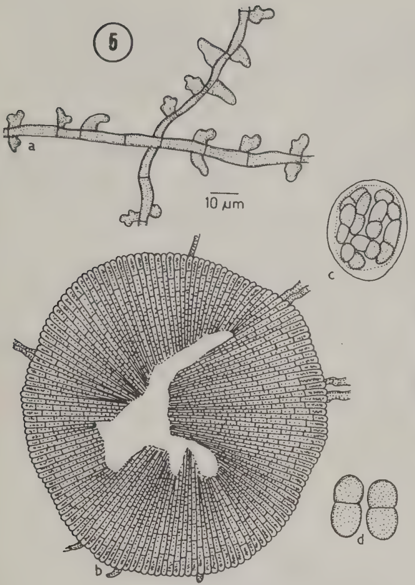
7. **Asterina congesta** Cooke, Grevillea 8: 95, 1879.

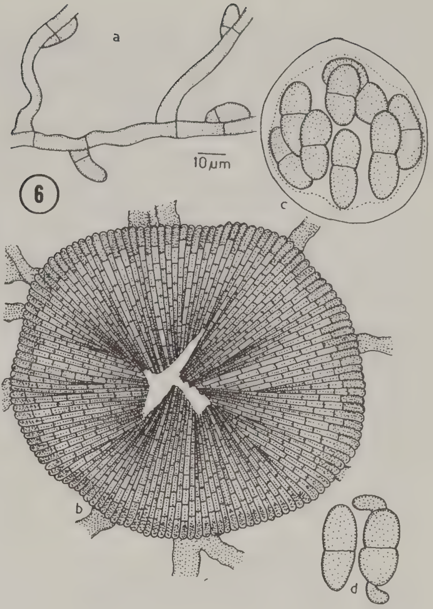
On leaves of Santalum album L. (Santalaceae), near Kadambarai, Anamalai, Coimbatore, Tamil Nadu, March 30, 1990, V.B. Hosagoudar HCIO 30958.

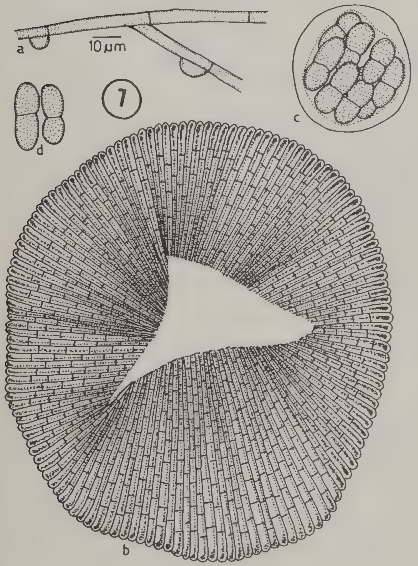
Hansford & Thirumalachar (1948) reported this species from Karnataka and it is reported here for the first time from Tamil Nadu. This species is very common throughout the Western Ghats wherever this host is found. During the winter season, this fungus covers the entire foliage. Further study is needed to assess crop loss.

8. **Asterina disciferae** V.B. Hosagoudar sp. nov. (Fig. 6)

Coloniae foliicolae, epiphyllae, densae, crustosae, ad 2 mm diam. Hyphae anthracinus nigrae, flexuosae vel anfractuae, opposite vel irregulariter acuteque ramosae, laxe vel densae reticulatae, cellulae 24-37.5 x 6-8 µm. Hyphopodia alternata, anthracinus nigra, stipitata, bicellula, antrorsa vel patentia, 12-15.5 µm longa; cellula basali cylindracea vel cuneata, 3-6.5 µm longa; cellula apicali globosa, ovata, integra, 9-12.5 x 9-12 µm. Thyrothecia dispersa, raro connata, orbicularia, 200-250 µm diam., stellato dehiscentes ad centre et dehiscentes ad margine, crenata vel fimbriata ad margine, hyphae fringiorae exhyphopodiatae, anfractuae; asci octospori, globosi ad







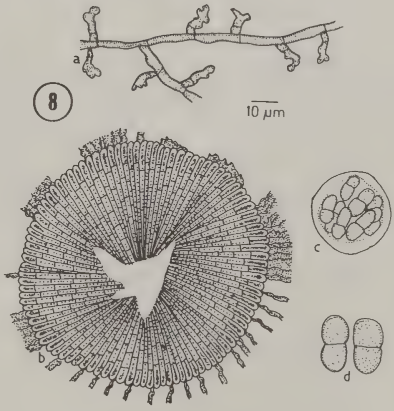


Fig. 5. *Asterina cipadessae*. Fig. 6. *Asterina disciferae*.
Fig. 7. *Asterina dissiliens*. Fig. 8. *Asterina erysiphoides* var. *indica*.

initio, ovati ad maturitati, 60-71.5 µm diam.; ascosporae cinnamomeo brunneae, conglobatae, oblongae, 1-septatae, profundae constrictae ad septatae, 34-40.5 x 15-15.5 µm, cellulae inferiorae saepe rotundae et cellulae superiorae ovatae, parietis glabrus.

Colonies foliicolous, epiphyllous, dense, crustose, up to 2 mm in diameter. Hyphae carbonaceous black, flexuous to crooked, branching opposite to irregular at acute angles, loosely to closely reticulate, cells 24-37.5 x 6-8 µm. Hyphopodia carbonaceous black, stipitate, two celled, antrorse to spreading, 12-15.5 µm long; stalk cells cylindrical to cuneate, 3-6.5 µm long; head cells globose, ovate, entire, 9-12.5 x 9-12 µm. Thyrothecia scattered, rarely connate, orbicular, 200-250 µm in diameter, dehiscing stellately at the centre, dehiscence extending up to margin, margin crenate to fimbriate, fringed hyphae exhyphopodiate, tortuous; asci eight spored, initially globose, slightly ovate at maturity, 60-71.5 µm in diameter; ascospores cinnamon brown, conglobate, oblong, 1-septate, deeply constricted at the septum, 34-40.5 x 15-18.5 µm, lower cell slightly rounded and upper cell ovate, wall smooth.

Holotype: On leaves of *Eugenia discifera* Gamble (Myrtaceae), Nooradi settlement, near Nirar Dam, Anamalai, Coimbatore, Tamil Nadu, Dec. 26, 1990, V.B. Hosagoudar HCIO 30959.

Etymology: named for the host species.

This species is close to *Asterina bukobensis* Hansf. and *A. pemphidioides* Cooke (Hansford, 1946; Doidge, 1942) in having 2-celled hyphopodia, and ascospores up to 40 um long. It differs from the former species in having smaller but normal two-celled hyphopodia with entire head cells, and from the latter species in having a dense epiphyllous colonies with sinuous to crooked hyphae. It also differs from *Asterina jambolana* Kar & Maity in having epiphyllous colonies and larger ascospores.

9. **Asterina dissiliens** (Sydow) Doidge, Bothalia 4: 287, 1942. (Fig. 7)

≡ *Asterinella dissiliens* Sydow, Ann. Mycol. 22: 425, 1924.

= *Parasterina reticulata* Doidge, Bothalia 1: 200, 1924

[non *Asterina reticulata* (Kalch. & Cooke) Doidge].

Colonies amphigenous, mostly epiphyllous, dense, orbicular, up to 5 mm in diameter, rarely confluent. Hyphae straight to flexuous, branching alternate to opposite, loosely to closely reticulate, cells 12-22 x 3-5 µm.

Hyphopodia very few, mammi-form, entire to sublobate, 4.5-6.5 x 6-9.5 µm. Thyrothecia numerous, centrally situated in the colonies, loosely to closely grouped, carbonaceous black, circular, 220-265 µm in diameter, dehiscing stellately at the centre, margin crenate to fimbriate, fringed hyphae numerous, tortuous; asci many, eight spored, initially globose, slightly ovoid at maturity, 43-46.5 x 21-27.5 µm; ascospores deep brown, conglobate, 1-septate, deeply constricted at the septum, 24-27.5 x 8-9.5 µm.

On leaves of Maytenus ovatus Wall. ex Wight & Arn. (Gymnosporia ovata (Wall. ex Wight & Arn.) Lawson) (Celastraceae), Pachakoomatchi Hills, Madurai, Tamil Nadu, Jan. 28, 1991, V. Lakshamanan HCIO 30960.

This is one of the most distinct species of the genus Asterina. Careful observation is needed to locate the hyphopodia, and an entire colony in situ should be mounted for study.

This species is reported here for the first time from India.

10. **Asterina elaeocarpi** Sydow var. **ovalis** Kar & Maity, Indian Phytopathol. 39: 218, 1836.

On leaves of Elaeocarpus tuberculatus Roxb. (Elaeocarpaceae), Karingundru, Valparai, Anamalai, Coimbatore, Tamil Nadu, Dec. 26, 1990, V.B. Hosagoundar HCIO 30961.

This taxon was reported from West Bengal (Kar & Maity, 1970) and is reported here for the first time from Southern India on a previously unrecorded host species.

11. **Asterina erysiphoides** Kalch, & Cooke, Grevillea 9: 32, 1880 emend. Doidge, Trans. Roy. Soc. South Africa 8: 256, 1920.

On leaves of Jasminum ritchiei Clarke (Oleaceae), Srimadurai, Gudalur, Nilgiris, Tamil Nadu, Jan 25, 1990, V.B. Hosagoudar HCIO 30962.

This species was reported from Karnataka (Hansford & Thirumalachar, 1948) and is reported here for the first time from Tamil Nadu on a hitherto unrecorded host species.

12. **Asterina erysiphoides** Kalch. & Cooke var. **indica** var. nov. (Fig. 8)

Differt a var. erysiphoides plagulis hyphophyllis, hyphopodiis plerumque oppositis.

Colonies hypophyllous, dense, carbonaceous black, up to 5 mm in diameter, confluent and covering the entire lower surface of the leaves. Hyphae light brown, straight, flexuous to crooked, branching alternate, opposite to irregular at wide angles, loosely reticulate, cells 12-15.5 x 3-5 µm. Hyphopodia alternate and opposite (30%), straight to curved, 2-celled, 8-15.5 µm long; stalk cells cylindrical to cuneate, 3-6.5 µm long; head cells ovate, globose, hamate, entire to variously lobate and in various shapes, 5-15.5 x 5-6.5 µm. Thyrothecia scattered to loosely grouped, orbicular, 90-125 µm in diameter, dehiscing stellately at the centre, margin crenate to fimbriate, fringed hyphae tortuous; asci many, globose to slightly ovate, eight spored, 27-31 x 24-26 µm; ascospores conglobate, cinnamon brown, 1-septate, constricted at the septum, 18-19 x 12-13 µm, lower cell globose, upper cell ovate, wall smooth. Pycnidia similar to thyrothecia, pycnidiospores brown, globose to pyriform, 15-21 x 12-13 µm.

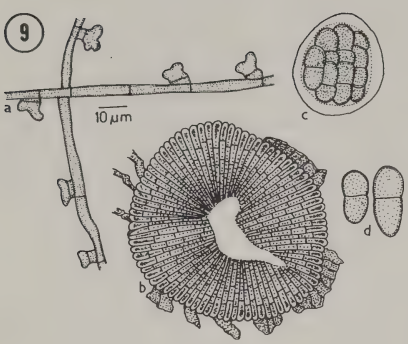
Holotype: On leaves of Jasminum cordifolium Wall. ex G. Don (Oleaceae), Srimadurai, Gudalur, Nilgiris, Tamil Nadu, Jan. 25, 1990, V.B. Hosagoudar HCIO 30962.

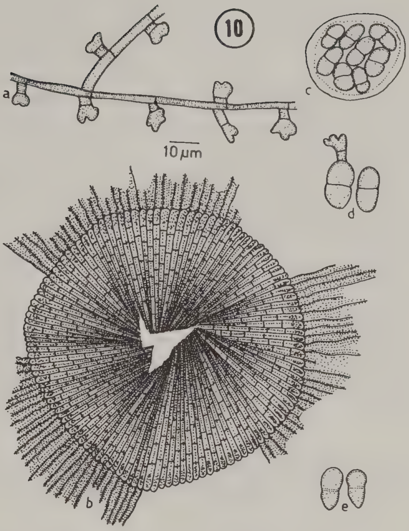
Etymology: from the country India.

This taxon is close to Asterina erysiphoides Kalch. & Cooke in having stipitate hyphopodia but the new variety differs from the var. erysiphoides in having only hypophyllous colonies and more opposite hyphopodia.

13. **Asterina flacourtiacearum** V.B. Hosagoudar et K. Ravikumar sp. nov. (Fig. 9)

Coloniae amphigenae, plerumque epiphyllae, tenues, ad 2 mm diam., saepe confluentes. Hyphae rectae, alternate vel irregulariter acuteque ramosae, laxe reticulatae, cellulae 24-31 x 5-6.5 µm. Hyphopodia dispersa, remote posita, alternata, plerumque 2-cellula, raro multicellula, 9-30 µm longa; cellula basali plerumque unicellularia, raro ad 3-cellula, plerumque cylindracea vel cuneata, raro irregulariter curvula, 3-22 µm longa; cellula apicali obpyriformia, saepe 2-3 sublobata vel lobata, raro integra vel angularia, 6-9.5 x 9-12.5 µm. Thyrothecia orbicularia, anthracina, 62-190 µm diam., ad centro stellatim dehiscentes ad maturitata, margine crenata vel fimbriata; asci numerosi, globosi vel ovati, octospori, 31-41 µm diam.; ascosporae cinnamomeo brunneae, conglobatae, 1-septatae, profunde constrictae ad septatae, cellulae superiorae leniter magniorae, 24-28 x 12-15.5 µm, parietis glabrus. Pycnidia similis thyrothecis, 70-90 µm diam.; pycnidiosporae unicellulariae, ovatae vel globosae, leniter papillatae, cinnamomeo brunneae, 15-22 x 15-18.5 µm.

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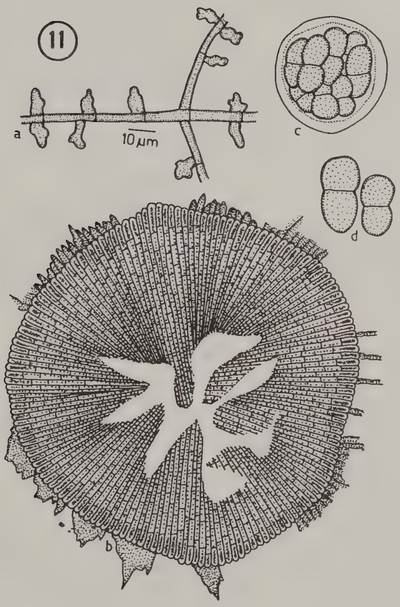

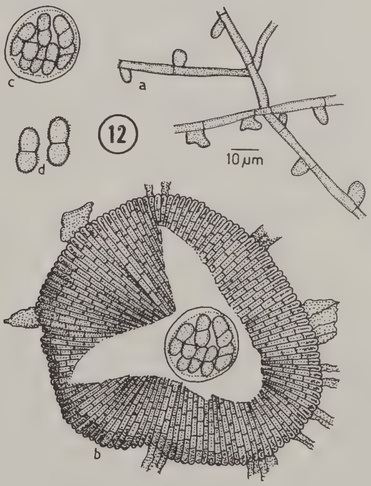

Fig. 9. Asterina flacourtiacearum. Fig. 10. Asterina goosii.
Fig. 11. Asterina granulosa. Fig. 12. Asterina litseae-ligustrinae.

Colonies amphigenous, mostly epiphyllous, up to 2 mm in diameter, frequently confluent. Hyphae straight, branching alternate to irregular at acute angles, loosely reticulate, cells 24-31 x 5-6.5 µm. Hyphopodia scattered, distantly arranged, alternate, mostly two-celled, occasionally several-celled, 9-30 µm long; stalk cells mostly unicullular, rarely up to 3-celled, mostly cylindrical to cuneate, rarely irregularly curved, 3-22 µm long; head cells obpyriform, frequently 2-3 lobate, rarely entire to angular, 6-9.5 x 9-12.5 µm. Thyrothecia orbicular, carbonaceous black, closely grouped to scattered, 62-190 µm in diameter, dehiscing stellately at the centre, margin crenate to fimbriate, fringed hyphae tortuous; asci many, globose, eight spored, 31-41 µm in diameter; ascospores cinnamon brown, conglobate, 1-septate, deeply constricted at the septum, upper cell slightly larger, 24-28 x 12-15.5 µm, wall smooth. Pycnidia similar to thyrothecia, 70-90 µm in diameter; pycnidiospores ovate to globose, slightly papillate at one end, cinnamon brown, 15-22 x 15-18.5 µm.

Holotype: On leaves of Scolopia crenata (Wight & Arn.) Clos (Flacourtiaceae), Pamba Ravane forest, Kodaikanal, Madurai, Tamil Nadu, Oct. 18, 1991, K. Ravikumar HCIO 30964.

Etymology: from the host family Flacourtiaceae.

Of the Asterina species reported on the members of Flacourtiaceae, this species is close to Asterina uncinata Doidge (Hansford, 1944; Doidge, 1942; Stevens & Ryan, 1939) in having one to several-celled hyphopodia but differs in having regularly lobate head cells and mostly single celled stalk cells of the capitate hyphopodia.

14. **Asterina goosii** V.B. Hosagoudar et N.P. Balakrishnan, sp. nov. (Fig. 10)

Coloniae epiphyllae, tantum raro hyphophyllae, densae, ad 3 mm diam., confluentes. Hyphae brunneae, rectae vel subrectae, alternate vel irregulariter acuteque ramosae, laxe reticulatae, cellulae 21-25 x 3-5 µm. Hyphopodia brunnea, alternata, ad 1% opposita, recta, antrorsa, 2-cellula, 9-12.5 µm longa; cellula basali cuneata, 3-4 µm longa; cellula apicali globosa, irregulariter sublobata vel lobata, 6-9.5 x 9-10 µm. Thyrothecia dispersa vel connata, rotunda vel ovata, 150-186 µm diam., stellato dehiscentes ad centre, margine fimbriata, hyphae fringiorae pallidae, flexuosae, non-hyphopodiatae; asci numerosi, octospori, globosi, 27-34.5 µm diam.; ascosporae conglobatae, hyalinae ad initio, astro-brunneae ad maturitatae, oblongae, rotundae ad ambiterminorae, 1-septatae, profunde constrictae ad septatae, 21-25 x 9-12.5 µm, parietis glabrus. Pycnidia similis in thyrothecia; pycnidiosporae oblongae, brunneae, leniter constrictae ad mediatae, incolor fiscia ad mediatis, 15-18.5 x 9-12.5 µm.

Colonies epiphyllous, very rarely few colonies hypophyllous, dense, up to 3 mm in diameter, confluent. Hyphae brown, straight to substraight, branching alternate to irregular at acute angles, loosely reticulate, cells 21-25 x 3-5 µm. Hyphopodia brown, alternate, about 1% opposite, straight, antrorse, 2-celled, 9-12.5 µm long; stalk cells cuneate, 3-4 µm long; head cells globose, irregularly sublobate to lobate, 6-9.5 x 9-10 µm. Thyrothecia round to ovate, scattered to connate, 150-186 µm in diameter, dehiscing stellately at the centre, margin fimbriate; fringed hyphae pale, flexuous, non-hyphopodiate, up to 62 µm long; asci many, eight spored, globose, 27-34.5 µm in diameter; ascospores conglobate, initially hyaline, dark brown at maturity, oblong, rounded at both ends, 1-septate, deeply constricted at the septum, 21-25 x 9-12.5 µm, wall smooth. Pycnidia similar to thyrothecia; pycnidiospores oblong, brown, smooth, slightly constricted in the middle, also with hyaline band at the middle, 15-18.5 x 9-12.5 µm.

Holotype: On leaves of Mahonia leschenaulti (Wall. ex Wight & Arn.) Takeda (Berberidaceae), Kodaikanal, Tamil Nadu, March 10, 1986, V.B. Hosagoundar HCIO 30965.

Etymology: this species is named in honour of Prof. R.D. Goos for his excellent contributions in the field of mycology.

This is the first report of the genus Asterina on members of the family Berberidaceae (Bilgrami et al. 1979, 1981; Doidge, 1942; Hansford, 1944, 1949; Hansford & Thirumalachar, 1948; Stevens & Ryan, 1939).

15. **Asterina granulosa** (Hansford) stat. et comb. nov.
Asterina grewiae Cooke var. granulosa Hansf., Proc. Linn. Soc. London 156: 114, 1943-44. (Fig. 11)

Colonies amphigenous, thin, up to 5 mm in diameter, confluent and covering most of the leaf surface. Hyphae straight to flexuous, branching mostly opposite at wide angles, loosely reticulate, cells 12-21.5 x 3-3.5 µm. Hyphopodia alternate and opposite, straight to curved, cylindrical, ovate, entire to sublobate, rounded to truncate at the apex, 8-13.5 x 6-8 µm. Thyrothecia scattered, round, 120-140 µm in diameter, dehiscing stellately at the centre, margin crenate to fimbriate, fringed hyphae brown, flexuous; asci many, globose, eight spored, 42-45 µm in diameter; ascospores conglobate, deep brown, 1-septate, both cells almost equal in size, 27-31 x 12-15.5 µm, wall smooth. Few pycnidiospores observed, deep brown, pyriform, slightly beaked, 24-25.5 x 15-16 µm.

On leaves of Scolopia crenata (Wight & Arn.) Clos (Flacourtiaceae), Kolithorai, Kotagiri, Nilgiris, Tamil Nadu, Oct. 10, 1991, V.B. Hosagoudar HCIO 30966.

Hansford (1944) described Asterina grewiae Cooke var. granulosa Hansf. on Scolopia sp. from Uganda. Doidge (1942) discussed the identity of the host of Asterina grewiae Cooke. This taxon has distinct characters that merit recognition at the species level.

16. **Asterina jambolana** Kar & Maity, Trans. Brit. Mycol. Soc. 54: 438, 1970.

On leaves of Syzygium cumini (L.) Skeels (Myrtaceae), on the way to Manjaparai, Anamalai, Coimbatore, Tamil Nadu, March 26, 1990, V.B. Hosagoudar HCIO 30967.

Kar & Maity (1970) described this species from West Bengal. Our collection differs slightly from the species description in having only epiphyllous colonies, larger head cells of the hyphopodia, smaller thyrothecia and asci.

17. **Asterina litseae** Yates, Philippine J. Sci. 13: 373, 1918.

Colonies amphigenous, mostly epiphyllous, thin to subdense, up to 5 mm in diameter, rarely confluent. Hyphae straight to substraight, branching opposite to irregular at wide angles, loosely reticulate, cells 12-22 x 3-5 µm. Hyphopodia alternate, about 40% opposite, unicellular, straight to curved, conoid to ampulliform, broadly rounded at the apex, 6-12.5 x 5-6.5 µm. Thyrothecia closely scattered, orbicular, 77-125 µm in diameter, dehiscing stellately at the centre, dehiscence extending up to the margin, the dehisced portion often dissolved and the inner deep yellow contents exposed, margin fimbriate, fringed hyphae many, crooked; asci many, globose, eight-spored, 18-25 µm in diameter; ascospores conglobate, deep brown, 1-septate, deeply constricted at the septum, 18-19 x 8-9.5 µm, upper cell ovate, lower cell globose, wall smooth.

On leaves of Litsea deccanensis Gamble (Lauraceae), Kolithorai, Kotagiri, Nilgiris, Tamil Nadu, Feb. 16, 1991, V.B. Kosagoudar HCIO 30968.

This species was reported from Philippines (Hansford, 1949). This is the first report from India and the first report of this species on this host.

18. **Asterina litseae-ligustrinae** sp. nov. (Fig. 12)

Coloniae hypophyllae, densae, crustosae, ad 5 mm diam., raro confluentes. Hyphae rectae vel subrectae, raro anfractuae, opposite vel irregulariter acuteque vel laxe ramosae, laxe reticulatae, cellulae 15-22 x 3-5 µm. Hyphopodia alternata, ad 15% opposita, recta vel curvula, unicellularia, conoidea, integra vel varie sublobata, 9-12.5 x 6-9.5 µm. Thyrothecia dispersa vel laxe aggregata, rotunda vel ovata, 90-110 µm diam., stellato dehiscentes ad centre, margine crenata vel fimbriata, hyphae fringiorae longae vel anfractuae; asci numerosi, globosi, octospori, 24-26 µm diameter, ascosporae conglobatae, brunneae, 1-septatae, constrictae ad septatae, 18-19 x 6-9.5 µm, cellulae superiorae leniter ovatae et cellulae inferiorae globosae, parietis echinulatus.

Colonies hyphophyllous, dense, crustose, up to 5 mm in diameter, rarely confluent. Hyphae straight to substraight, in few places crooked, branching opposite to irregular at acute to wide angles, loosely reticulate, cells 15-22 x 3-5 µm. Hyphopodia alternate, about 15% opposite, straight to curved, unicellular, conoid, entire to variously sublobatae, 9-12.5 x 6-9.5 µm. Thyrothecia scattered to loosely grouped, round to ovate, 90-110 µm in diameter, stellately fissured at the centre, inner contents deep yellow, margin crenate to fimbriate, fringed hyphae long and tortuous; asci many, globose, eight spored, 24-26 µm in diameter; ascospores conglobate, 1-septate, constricted at the septum, 18-19 x 6-9.5 µm, upper cell slightly ovate, lower cell globose, wall echinulate.

Holotype: On leaves of Litsea ligustrina (Nees) Hook.f. (Lauraceae), Kolithorai, Kotagiri, Nilgiris, Tamil Nadu, Feb. 6, 1991, V.B. Hosagoudar HCIO 30969.

This species is similar to Asterina litseae Yates in having yellow contents in the thyrothecia (Hansford, 1949) but differs from it in having hypophyllous colonies, substraight to crooked hyphae, 15% opposite, and entire to variously sublobate hyphopodia, and echinulate ascospores.

19. **Asterina microtropidis** sp. nov. (Fig. 13)

Coloniae amphigenae, densae, velutinae, ad 2 mm diam., confluentes. Hyphae brunneae, subrectae vel anfractuae, opposite vel irregulariter acuteque vel laxe ramosae, densae reticulatae, cellulae 21-28 x 4.5-6.5 µm. Hyphopodia unicellularia, alternata vel unilateralia, plerumque cylindracea, recta vel plerumque curvula, saepa rotunda ad apicem, 12-12.5 x 3-4.5 µm. Thyrothecia dispersa vel aggregata, orbicularia, 162-172 µm diam., stellato dehiscentes ad centre, margine crenata; asci numerosi, globosi vel ovati, octospori, 55-62 x 43-46.5 µm; ascosporae conglobatae, hyaline ad initio, astro-brunneae ad maturitatae, 1-septatae, profunde constrictae ad septatae, 24-28 x 12-15 µm, cellulae superiorae leniter magniorae, parietis echinulatus.

Colonies amphigenous, dense, velvety, up to 2 mm in diameter, confluent. Hyphae brown, septate, substraight to crooked, branching opposite to irregular at acute to wide angles, closely reticulate, cells 21-28 x 4.5-6.5 µm. Hyphopodia unicellular, alternate to unilateral, cylindrical, straight to predominently and variously curved, broadly rounded at the apex, 12-15.5 x 3-4.5 µm. Thyrothecia scattered to grouped, orbicular, 162-172 µm in diameter, dehiscing stellately at the centre, margin crenate; asci many, globose to ovate, eight spored, 55-62 x 43-46.5 µm; ascospores conglobate, initially hyaline, dark brown at maturity, 1-septate, deeply constricted at the septum, upper cell slightly larger than the lower, 24-28 x 12-15 µm, wall echinulate.

Holotype: On leaves of Microtropis ovalifolia Wight (Celastraceae), Painavu, Idukki, Kerala, Oct. 24, 1984, V.B. Hosagoudar HCIO 30970.

This species is close to Asterina dissiliens (Sydow) Doidge but differs from it in having cylindrical and longer hyphopodia, smaller thyrothecia, and larger asci and ascospores. It also differs from A. dissiliens (Sydow) Doidge var. senegalensis Doidge in having cylindrical hyphopodia and larger ascospores.

20. **Asterina nothopegiae** Ryan, Mem. Dept. Agric. India 15: 104, 1927.

Colonies amphigenous, mostly epiphyllous, thin, up to 5 mm in diameter, confluent. Hyphae straight, branching opposite at wide angles, loosely reticulate, cells 9-22 x 3-5 µm. Hyphopodia alternate and about 40% opposite, unicellular, ovate, globose to conoid, entire to deeply and irregularly shallowly to deeply lobate, 6-12.5 x 6-8 µm. Thyrothecia scattered, round to slightly ovate, 108-155 µm in diameter, dehiscing stellately at the centre, margin crenate to fimbriate, fringed hyphae flexuous; asci many, globose to ovate, eight spored, 30-32 x 21-25 µm; ascospores conglobate, deep brown, broadly ovoid to ellipsoidal, 1-septate, constricted at the septum, 21-25 x 9-10 µm, lower cell globose, upper cell broadly ovate, ends rounded, wall smooth.

On leaves of Nothopegia colebrookiana (Wight) Blume (Anacardiaceae), Kolithorai, Kotagiri, Nilgiris, Tamil Nadu, Feb. 16, 1991, V.B. Hosagoudar HCIO 30971.

The original description of this species was not given in detail and an expanded description is given here.

21. **Asterina oreocnidecola** sp. nov. (Fig. 14)

Coloniae amphigenae, plerumque epiphyllae, raro hypophyllae, tantum tenues, ad 3 mm diam., confluentes. Hyphae brunneae, rectae vel undulatae, alternate vel opposite laxe ramosae, laxe reticulatae, cellulae 9-15.5 x 3-5 µm. Hyphopodia pallide brunnea, unicellula, alternata vel unilateralia, globosa, stellato sublobata, raro integra, 4.5-6 x 7-9.5 µm. Thyrothecia dispersa, plerumque orbicularia, ad 100 µm diam., asterineus dehisco ad centre, margine crenata vel fimbriata, hyphae fringiorae pallidae, leniter flexuosae; asci numerosi, globosi vel ovati, octospori, 27-28 x 21-25 µm; ascosporae brunneae, conglobatae, 1-septatae, 18-19 x 9-11 µm, cellulae inferiorae leniter magniorae, parietis glabrus.

Colonies amphigenous, mostly epiphyllous, rarely hypophyllous, up to 3 mm in diameter, confluent, very thin, sometimes difficult to trace. Hyphae brown, straight to undulate, branching alternate to opposite at wide angles, loosely reticulate, cells 9-15.5 x 3-5 µm. Hyphopodia pale brown, unicellular, alternate to unilateral, globose, stellately sublobate, rarely entire, 4.5-6 x 7-9.5 µm. Thyrothecia scattered, mostly round, up to 100 µm in diameter, dehiscing stellately at the centre, margin crenate to fimbriate, fringed hyphae yellow, slightly flexous; asci many, globose to ovate, eight spored, 27-28 x 21-25 µm; ascospores brown, conglobate, 1-septate, 18-19 x 9-11 µm, one cell slightly larger, wall smooth.

Holotype: On leaves of Oreocnide integrifolia (Gaudich.) Miq. (Villebrunea integrifolia Gaudich.) (Urticaceae), near Manjaparai, Anamalai, Coimbatore, Tamil Nadu, March 23, 1990, V.B. Hosagoudar HCIO 30972.

Asterina fleuryae Doidge, A. phaleriae Mandoza, A. phenacis Sydow and A. pipturi Sydow have been reported on the genera Fleurya, Phaleria, Phenax and Pipturus of the family Urticaceae. The new species differs from all these in having very thin epiphyllous colonies, alternate to unilateral and stellately lobate hyphopodia. It also differs in the measurements of thyrothecia, asci and ascospores. Further, the above hosts are not known from India (Santapau & Henry, 1971).

22. **Asterina tertia** Rec. var. **africana** Doidge, Trans. Roy. Soc. South Africa 8: 264, 1920.

Colonies epiphyllous, thin, up to 2 mm diameter, confluent. Hyphae brown, straight to substraight, branching mostly opposite at wide angles, loosely reticulate, cells 15-25 x 3-5 µm. Hyphopodia predominently sessile, rarely 1-septate, scattered, alternate, brown, globose, irregularly sublobate to deeply lobate and sometimes the lobes give finger like appearance, 5-6.5 x 6-9.5 µm. Thyrothecia not seen. Pycnidia scattered to connate, orbicular, 58-76 µm,

stellately fissured at the centre, the fissured portion later dissolving and exposing the pycnidiospores, margin crenate to fimbriate, fringed hyphae radiating, tortuous, brown; pycnidiospores cinnamon brown, ovate, ellipsoidal to pyridiform, 15-18.5 x 9-12.5 µm, wall smooth.

On leaves of Eranthemum capense L. var. capense (Acanthaceae), Benne forest, Gudalur, Nilgiris, Tamil Nadu, Jan. 24, 1990, V. B. Hosagoudar HCIO 30972.

Repeated collections revealed only the pycnidial state but the overall morphology matches well with the species to which it has been assigned.

23. **Asterina travancorensis** Sydow & Sydow, Ann. Mycol. 13: 38, 1915.

On leaves of Wattakaka volubilis (L.f.) Stapf (Marsdenia volubilis (L.f.) Cooke) (Asclepiadaceae), near Nooradi settlement, Nirar dam, Valparai, Tamil Nadu, March 23, 1990, V.B. Hosagoudar HCIO 30974.

Sydow & Sydow (1915) described this species on Marsdenia sp., collected by E.J. Butler from Pulliyanur, Travancore of Kerala state on Oct. 9, 1907. This is the first report subsequent to the type collection.

24. **Asterina wingfieldii** sp. nov. (Fig. 15)

Coloniae epiphyllous, tenues, ad 2 mm diam., confluentes. Hyphae cinnamomeo brunneae, flexuosae vel anfractuae, opposite vel irregulariter acuteque ramosae, laxe reticulatae, cellulae 12-18.5 x 3-4 µm. Hyphopodia cinnameo-brunnea, unicellularia, alternata vel irregulariter posita, recta vel varie curvula, globosa, versiformia, integra, angularia vel sublobata, 3-6.5 x 6-8 µm. Thyrothecia dispersa vel aggregata, saepa connata, orbicularia vel leniter ovata, ad 124 µm diam., stellato dehiscentes ad centre, margine fimbriata, hyphae fringiorae exhyphopodiatae, flexuosae vel anfractuae; asci numerosi, globosi, octospori, 24-31 µm diam.; ascosporae conglobatae, intense brunneae, 1-septatae, profunde constrictae ad septatae, 15-18.5 x 9-12.5 µm, cellulae superiorae leniter magniorae, parietis glabrus.

Colonies epiphyllous, thin, up to 2 mm in diameter, confluent. Hyphae cinnamon brown, flexuous to crooked, branching opposite to irregular at acute angles, loosely reticulate, cells 12-18.5 x 3-4 µm. Hyphopodia cinnamon brown, unicellular, alternate to irregular, straight to variously curved, globose, versiform, entire, angular to sublobate, 3-6.5 x 6-8 µm. Thyrothecia scattered to grouped, often connate, circular to ovate, up to 124 µm in diameter, dehiscing stellately at the centre, margin crenate

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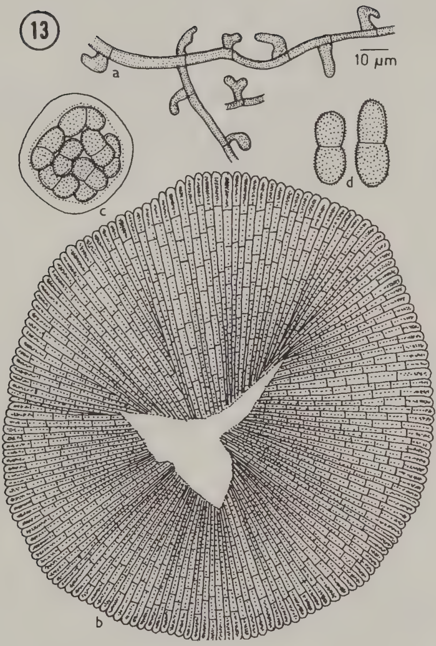

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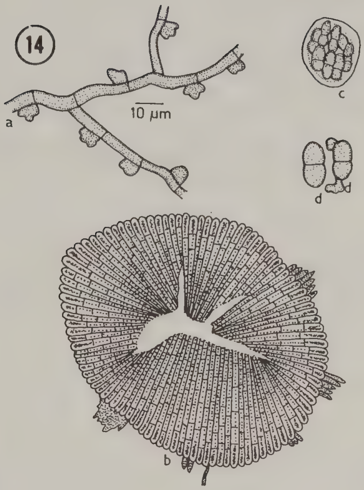

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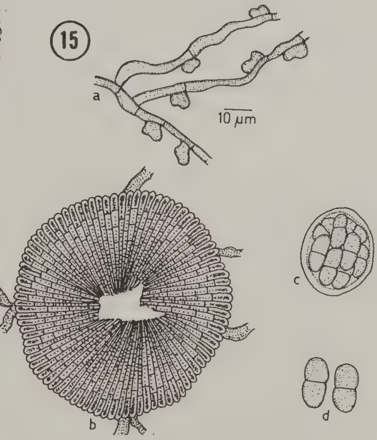

Fig. 13. Asterina microtropidis. Fig. 14. Asterina oreocnidecola.
Fig. 15. Asterina wingfieldii.

to fimbriate, fringed hyphae exhyphopodiate, flexuous to crooked; asci many, globose, eight spored, 24-31 µm in diameter; ascospores conglobate, deep brown, 1-septate, deeply constricted at the septum, 15-18.5 x 9-12.5 µm, upper cell slightly larger, wall smooth.

Holotype: On leaves of *Grewia* sp. (Tiliaceae), Shankaran kudi, High forest, Valparai, Coimbatore, Tamil Nadu, Oct. 27, 1990, V.B. Hosagoudar HCIO 30975.

Etymology: this species is named in honour of Prof. M.J. Wingfield of South Africa.

The new species is similar to *Asterina delicata* Doidge (Doidge, 1942) but differs from it in having only epiphyllous colonies, flexuous to crooked hyphae, unicellular and smaller hyphopodia, and smaller thyrothecia, asci and ascospores.

This species was associated with *Irenopsis* sp.

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STUDIES ON KERATINOPHILIC FUNGI. VII. ***Chrysosporium vespertilium*** *sp. nov.* from Zaire

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ABSTRACT

Chrysosporium vespertilium *sp. nov.* is described and illustrated and its relationships to the other species of ***Chrysosporium*** are briefly discussed. The species is characterized by having typically yellow colonies and long and coiled sterile hyphae; fertile hyphae are warty, frequently constricted at septa and branching orthotropically. Conidia are clavate to cylindrical, yellowish and verrucose.

RESUMEN

Se propone a ***Chrysosporium vespertilium*** como nueva especie para la ciencia y se describe, ilustra y discute su posición taxonómica. Se caracteriza por presentar colonias típicamente amarillas, hifas estériles largas y espiraladas, hifas fértiles verrucosas, frecuentemente constreñidas en los septos y con ramificaciones en ángulo recto y conidios amarillentos, mazudos a cilíndricos y de pared verrucosa.

INTRODUCTION

During a study of keratinophilic fungi deposited at the Institute of Tropical Medicine `Prince Leopold' of Antwerpen (Belgium), two strains of ***Chrysosporium*** isolated from intestinal content of bat in Zaire are considered sufficiently distinct from other taxa in the genus to justify their description as a new species.

TAXONOMY

Chrysosporium vespertilium Guarro, Vidal *et* de Vroey *sp. nov.*
Figs. 1-3.

(*Etym*: *vespertilio* = bat, the latin name referring to the animal from which the fungus was isolated).

Coloniae in agaro PYE ad 25°C moderatim crescunt, 35-45 mm diametri post 14 dies, primo albae, postea clare luteolae, in margine albae, pulvisculae vel floccosae, compactae, planae, aliquando in medio tenuiter radiato-striatae, margo definitus; reversum pallide luteolum. Ad 37°C non crescunt. Hyphae subhyalinae vel luteolae, septatae, dense ramosae, tenuitunicatae, primo laeves, deinde verrucosae, usque ad 8 µm crassae; in maturitate frequenter constrictae in septis. Hyphae steriles oriundae ex hyphis fertilibus praesentes, spirales vel undulatae, septatae, tenuitunicatae, laeves, in basi rare verrucosae, usque 400 µm longae, ad 3µm crassae. Hyphae reticulatae praesentes. Conidia terminalia et lateralia, sessilia vel oriunda ex protrusionibus vel ramulis lateralibus frequenter in angulo recto dispositis, solitaria, primum hyalina, laevia et tenuitunicata, deinde luteola, verrucosa et crassitunicata, clavata, unicellularia, aliquando bicellularia et rare tricellularia, (3-)5-8(-20) x (1.5-)2-4(-5) µm, cicatrice basilari 1-2.5 µm. Conidia intercalaria rara, solitaria vel subinde catenata, primum hyalina, laevia et tenuitunicata, deinde luteola, verrucosa et crassitunicata, cylindrica vel unilateraliter inflata, (4-)7-13.5(-17) x (1-)2-3(-5) µm. Chlamydosporae absentes. Species keratinolytica et non cellulosolytica. Reproductio sexualis ignota.

Holotypus: IMI 357403, *ex vespertilii.*

Colonies on phytone yeast-extract agar (PYE) attaining 35-45 mm in 14 days at 25°C, characteristically light yellow (2A4 to 3A4) (KORNERUP & WANSCHER, 1978) with a narrow white margin, powdery to mealy and scarsely floccose, fairly dense, slightly raised and often radially folded, sometimes with droplets of yellow exudate (2A4), margin sometimes slightly lobulate and well defined; reverse with light yellow (4A5) to greyish orange (5B4) center and whitish periphery. Odour mouldy.

Hyphae septate, repeatedly branched, subhyaline to yellowish, wall thin, first smooth and later warty, up to 8 µm in width; at maturity becoming constricted at septa and forming long and sterile appendages. Appendages septate, subhyaline to yellowish, characteristically wavy or loosely coiled, tapering toward the apex, thin- and smooth-walled, rarely warty at the base, up to 400 x 3 µm.

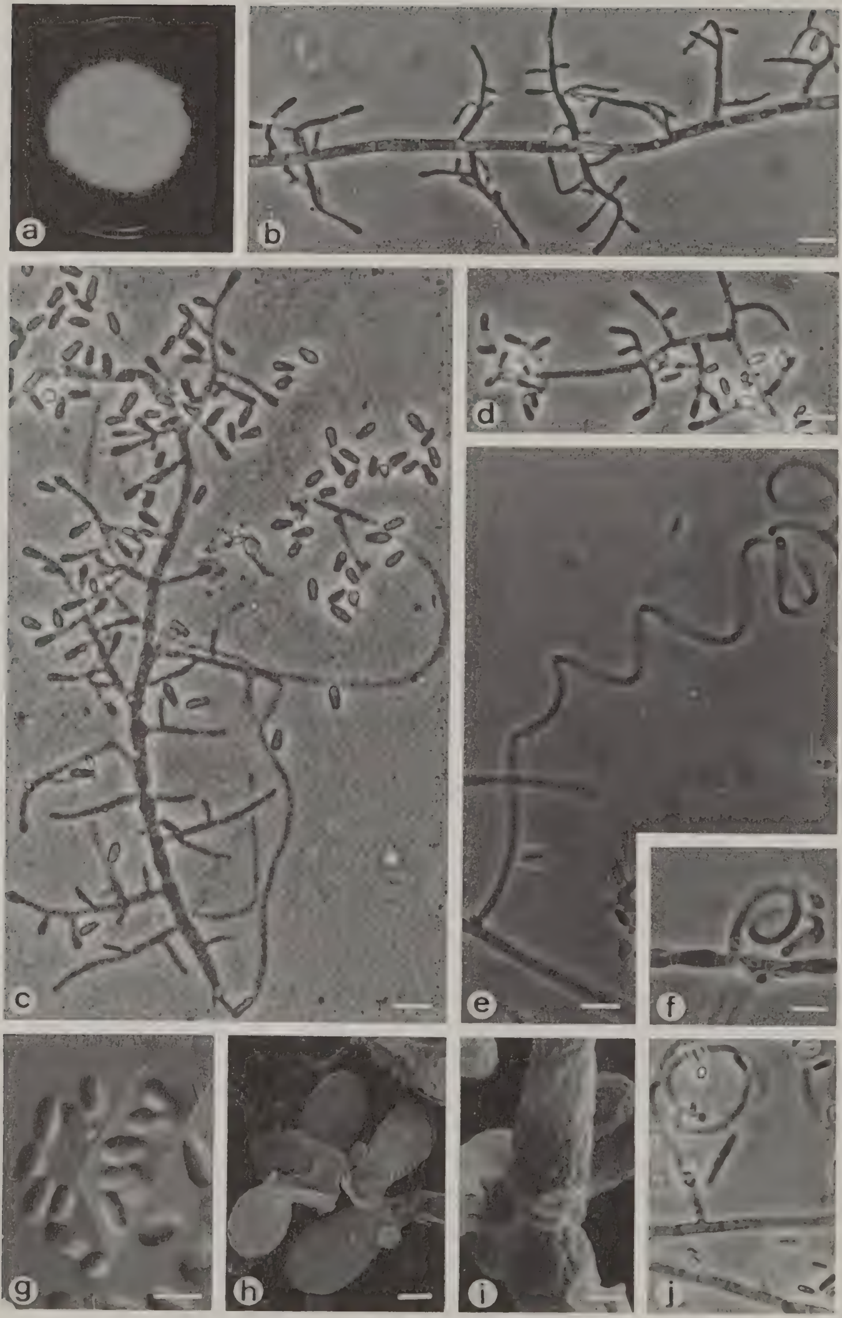
Conidia abundant, sessile or borne on short protrusions or on long side branches developing at more or less right angles to each other, solitary, mostly clavate, sometimes pyriform, 1-, occasionally 2- and rarely 3-celled, (3-) 5-8(-20) x (1.5-)2-4(-5) µm, with a basal scar 1-2.5 µm wide, wall initially hyaline, smooth and thin, later yellowish, thick and warty; intercalary conidia rare, solitary, occasionally catenate, cylindrical or unilaterally inflated, 7-13.5 x 1-2.5 µm, wall initially hyaline, smooth and thin, later yellowish, thick and warty. Chlamydospores not observed. Racquet hyphae present. Teleomorph unknown.

Colonies on Sabouraud agar (SAB) and potato dextrose agar (PDA) are similar to those on PYE.

Growth temperatures: minimum 12°C, optimum 20-25°C, maximum 30°C. Resistant to cycloheximide (0.04 %). Keratinolytic. Not cellulolytic.

Material examined: IMI 357403 (**holotype**), (**isotypes:** FMR 3752, RV 27093), 16.01.71. IMI 357404 (=FMR 3814, RV 27084), 18.01.71. Both strains were isolated at the University of Kinshasa, from the intestinal content of the same bat captured in a cave near Kibisi (Sanda, about 50 km S.E: from Kinshasa, Zaire).

Fig. 1. ***Chrysosporium vespertilium*** IMI 357403. a. Colonial morphology on PYE at 25°C after 21 days, b-d. Fertile hyphae with conidia (bar = 10µm). e,f,j. Sterile appendages (bar = 10µm). g,h. Conidia (g. bar = 5µm; h. bar = 10µm). i. Fertile hyphae constricted at septa (bar = 1µm).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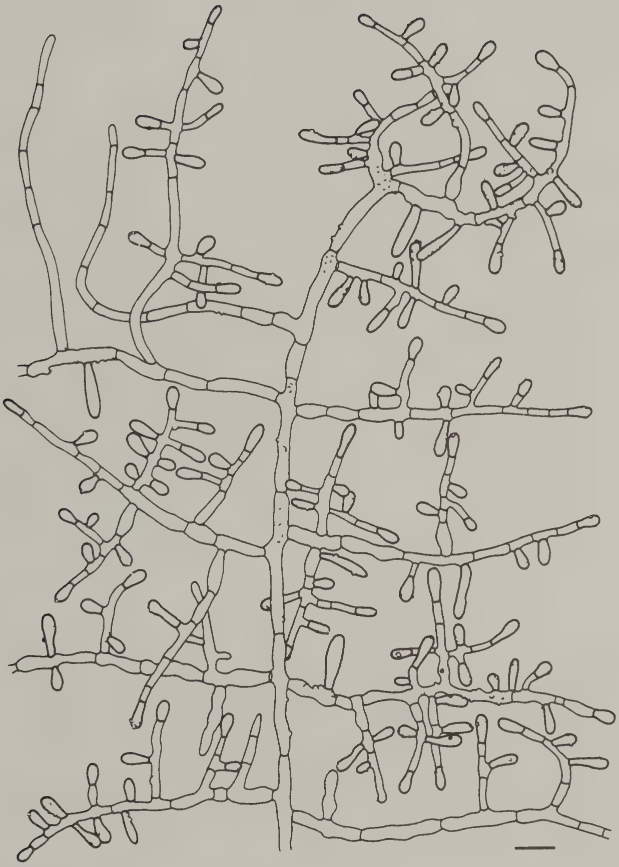

Fig. 2. ***Chrysosporium vespertilum*** IMI 357403. Fertile hyphae (bar = 10 µm).

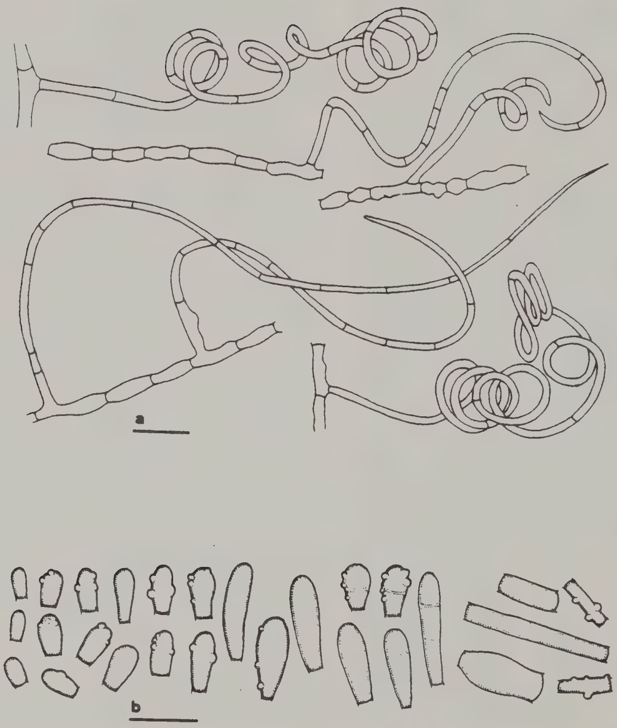

Fig. 3. ***Chrysosporium vespertilium*** IMI 357403. a. Sterile appendages (bar = 10μm). b. Mature conidia (bar = 10 μm).

C. vespertilium differs from other described species of ***Chrysosporium*** in its warty fertile hyphae, frequently constricted at septa and branched orthotropically, and by its long, coiled appendages. In appearance, these appendages suggest those that arise from some gymnoascaceous teleomorphs, but no ascoma could be obtained by crossing the isolates in all possible combinations under a variety of growth conditions. In the colour of the colony, ***C. vespertilium*** is comparable to ***C. keratinophilum*** Frey *ex* Carmichael (OORSCHOT, 1980), the ***Chrysosporium*** anamorph of ***Renispora flavissima*** Sigler, Gaur, Lichtwardt *et* Carmichael (SIGLER *et al.*, 1979), ***C. merdarium*** (Link *ex* Grev.) Carmichael (OORSCHOT, 1980), ***C. pseudomerdarium*** van Oortschot (OORSCHOT, 1980), ***C. sulfureum*** Fieldl., van Oortschot *et* Samson (OORSCHOT, 1980) and ***C. vallenarense*** van Oorschot *et* Piontelli (OORSCHOT & PIONTELLI, 1985). ***C. merdarium*** and ***C. pseudomerdarium*** differ by the abundance of intercalary conidia which are rare in ***C. vespertilium***. This species is easily distinguishible from the other mentioned species by its narrower (rarely exceeding 4 µm), 0-1-2-septate and clavate rather than globose to subglobose conidia. Other species, such as ***C. georgii*** (Varsavsky & Ajello) van Oorschot (OORSCHOT, 1980), the ***Chrysosporium*** anamorph of ***Arthroderma curreyi*** Berk (OORSCHOT, 1980), the ***Chrysosporium*** anamorph of ***A. cuniculi*** Dawson (OORSCHOT, 1980) and ***C. filiforme*** Sigler, Carmichael *et* Whitney (SIGLER *et al.*, 1982), also have 2- or 3-celled conidia. Furthermore, ***C. georgii*** can also produce sterile coiled appendages. The former species, except the ***Chrysosporium*** anamorph of ***A. curreyi***, are mainly distinguished from ***C. vespertilium*** by their smooth-walled conidia, and the **C.** anamorph of ***A. curreyi*** by having white colonies, smaller conidia and an associated teleomorph. ***C. vespertilium*** resembles some species of ***Trichophyton*** on the presence of sterile coiled appendages, the disposition of conidia on orthotropically branched fertile hyphae and multicellular conidia. However, in the latter, macroconidia are smooth-walled and broader than the microconidia.

ACKNOWLEDGEMENTS

We thank Dr. E. Descals (C.S.I.C.) for critically reading the manuscript and Dr. J.M. Escolà (Universitat Rovira i Virgili) for reviewing the Latin diagnoses. This study was supported by grant no. 92/0785 (FISss, Ministerio de Sanidad y Consumo, Spain).

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MYCOTAXON

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A NEW *ZOPFIELLA* (LASIOSPHAERIACEAE) FROM IRAQ

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ABSTRACT

Zopfiella cephalothecoidea sp. nov., isolated from unidentified dead twig collected from the Euphrates, Southern Iraq, is described and illustrated. The fungus is distinguished by its cephalothecoid peridium and by the large ascospores.

Key words: ***Zopfiella cephalothecoidea***, ascomycetes, Iraq.

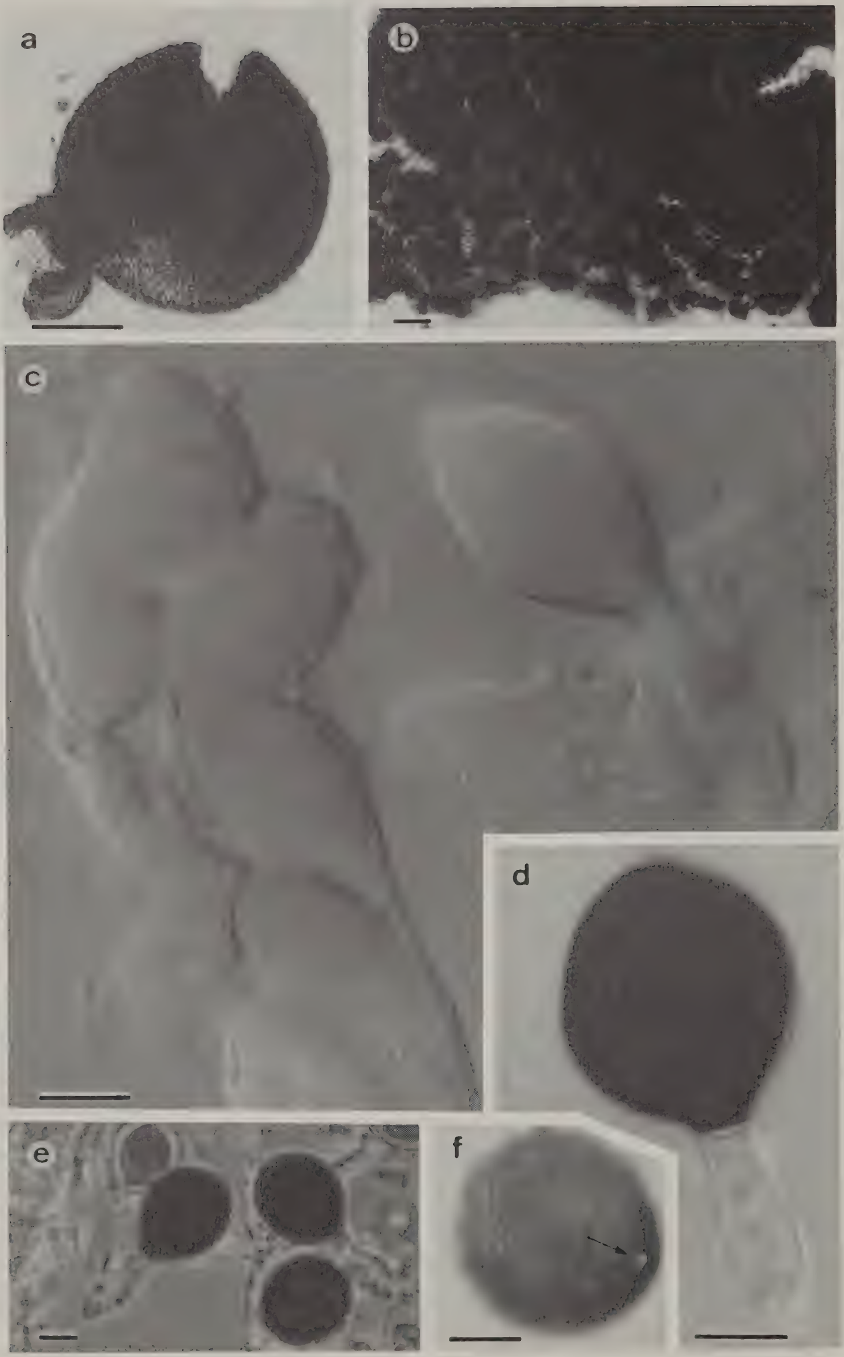
RESUMEN

Se describe e ilustra ***Zopfiella cephalothecoidea*** sp. nov. aislada de una rama muerta no identificada colectada en el Eufrates en el sur de Irak. Dicho hongo está caracterizado por un peridio cefalotecoide y por sus grandes ascosporas.

Palabras clave: ***Zopfiella cephalothecoidea***, ascomicetes, Irak.

INTRODUCTION

During a survey of mycota colonizing a variety of dead plant substrates submerged in freshwater and marine habitat in Iraq (Abdullah & Al-Saadoon, 1994a, 1994b, 1995), several rare species have been isolated. Among the isolates an interesting ascomycete, characterized by a peculiar peridium and bicellular ascospores, was developed in a moist chamber on unidentified dead twig collected from the Euphrates near Battha town, De Qar governorate, Southern Iraq. The fungus was identified as a species of ***Zopfiella*** Winter. A comparison with the currently known species of ***Zopfiella*** (Guarro *et al.*, 1991), showed that the present isolate has not been described so far, and is proposed here as a new species. The description of the fungus is based on a collection from the natural substrate because in artificial culture all the attempts to obtain fruiting bodies were unsuccessful.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DESCRIPTION

Zopfiella cephalothecoidea Guarro, Abdullah, Alsaadoom et Gené, sp. nov.

(Figs. 1, 2)

Coloniae in agaro "oat-meal", celeriter crescent, cum hyphis radiantis, latis, crassis, septatis. Hyphae 1.5-3 µm crassae, hyalinae usque brunnae. Ascomata superficialia, globosa, usque subglobosa, cleistocarpa, 310-350 x 310-340 µm. Peridium cephalothecoideum. Asci clavate, octospori, 140-180 x 30-40 µm, evanescentes. Ascosporae bicellulares; cellula superiora 28.5-37 x 23.5 x 27 µm, late ellipsoidea, atrobrunnea; cellula inferiora 22-26 x 8-10 (ad basim) µm, obclavata, hyalinae usque clara brunnae, foramine germinale ad apicem sito.
Anamorphus non formatus.

Holotypus: FMR 5307.

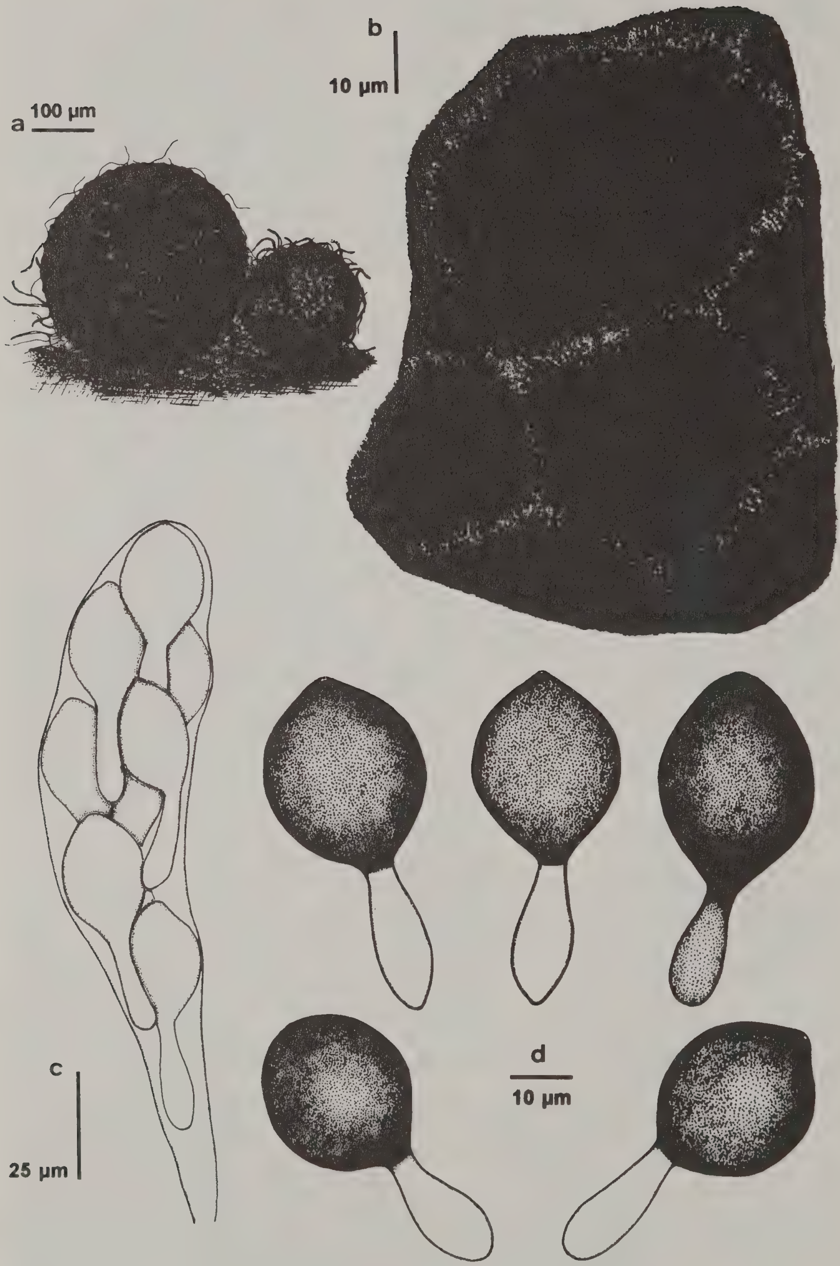
Colonies on oatmeal agar rapidly expanding, attaining a diam of 50-55 mm in 15 d at 25°C, with broad and regularly septate hyphae, white at first but becoming olive to black. Hyphae hyaline to brown, 1.5-3 µm in diam. Ascomata superficial, globose to subglobose, non-ostiolate, 310-350 x 310-340 µm, black. Peridium coriaceous, cephalothecoid, consisting of irregular plates of 7-15 µm diam, composed of hyphae radiating from a central point, organized in larger polygonal plates up to 60 µm in diam, dark brown; the most internal layers are thin-walled, colourless, appearing as *textura angularis* in cross section, 10-15 µm thick, composed of several rows of thin cells. Asci clavate, 8-spored, evanescent, the apex rounded, 140-180 x 30-40 µm, paraphyses not observed. Ascospores two-celled; upper cell 28.5-37 x 23.5-27 µm, broadly ellipsoidal, thick-walled, the apex rounded and sometimes apiculate, the base truncate, dark brown, with a conspicuous apical germ pore; lower cell 22-26 x 8-10 (at the widest part) µm, obclavate to spathulate with a rounded or slightly apiculate end, hyaline to pale brown, occasionally dark brown, more or less thin-walled.
Anamorph: Not known.

Holotype: FMR 5307 on unidentified dead twig submerged in the Euphrates, Battha town, De Qar governorate, Iraq, 20-6-1994, leg. S.K. Abdullah. **Isotypes** in IMI and BSRA (10412).

DISCUSSION

The genus *Zopfiella* (Lasiosphaeriaceae) has been recently reviewed by Guarro *et al.* (1991) and nineteen species have been accepted. The main features of *Zopfiella* are the presence of ascoma which are non-ostiolate and globose, and ascospores which are bicellular with a dark pigmented upper cell and a hyaline to pale yellowish lower cell. The ascomata can sometimes

Fig. 1. ***Zopfiella cephalothecoidea***, FMR 5307. **a.** Ascoma; **b.** Peridium in surface view; **c.** Part of the ascus and young ascospores; **d-f.** Ascospores (arrow, germ pore of an ascospore) (bar: a = 100µm, b = 25µm; c-f = 10µm).


b
10 µm
a 100 µm
c
25 µm
d
10 µm

be ostiolate and then the distinction from some soil-borne ***Podospora*** Ces. species is not easy. Although numerous exceptions exist in ***Podospora***, the ascomata of that genus show a tendency towards a perithecial habit and the ascospores usually have gelatinous appendages. Most ***Podospora*** species are isolated from dung rather than soil or plant debris as is usual for ***Zopfiella***. ***Z. cephalothecoidea*** is the second species of the genus, after ***Z. tabulata*** Winter, having a cephalothecoid peridium. In the latter the peridium tears irregularly to release its ascospores, contrary to what occurs in ***Z. cephalothecoidea*** and in ***Diffractella curvata*** Guarro *et al.*, a species previously considered also as a ***Zopfiella***. In these two species the peridium fractures along pre-determined lines such as happens in other members of Eurotiales and Dothideales. ***D. curvata*** differs clearly from ***Zopfiella*** species as it has globose asci, irregularly dispersed within the ascoma, containing fasciculately arranged ascospores. ***Z. tabulata*** has four-spored asci and the spores are smaller than those of ***Z. cephalothecoidea***.

In other genera of Lasiosphaeriaceae the presence of a similar peridium is frequent such as in the case of ***Cercophora*** Fuckel and ***Arnium*** Nitschke, where in numerous species the peridia are arranged in indistinct areoles or patches with a dark centre distributed over the whole surface or only localized below the neck; but in some species they are very conspicuous as in ***Arnium tomentosum*** (Spg.) Lundq. & Krug and especially in ***Cercophora areolata*** Lundq., which displays broad polygonal patches when crushed. However, the ascomata of these genera are markedly ostiolate. The existence of this type of peridium in fungi with ostiolate ascomata is difficult to explain as their spore dispersal is not produced by a spontaneous break of the ascomata wall (Lundqvist, 1972).

In ***Zopfiella*** there are several species with large ascospores like ***Z. cephalothecoidea***, whose upper cell can reach a length of 30 μm or more, such as ***Z. tabulata*** Winter, ***Z. tetraspora*** Malloch & Cain, ***Z. ovina*** (Udagawa) Guarro, ***Z. macrospora*** Guarro & Calvo, ***Z. udagawae*** Guarro & Punsola and ***Z. inermis*** (Cailleux) Malloch & Cain but in none of them is the upper cell of the ascospores broader than 23 μm.

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We thank Dr. P.F. Cannon (IMI) for critical review of this paper.

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Abdullah, S.K. & A.H. Al-Saadoon. 1994b. *Arxiomyces zubairiensis* sp. nov. from the Khawr Al-Zubair estuary, Southern Iraq. *Marina Mesopotamica* **9**: 245-250.

Fig. 2. ***Zopfiella cephalothecoidea***, FMR 5307. **a.** Ascomata; **b.** Part of the peridium in surface view; **c.** Ascus; **d.** Ascospores.

Abdullah, S.K. & A.H. Al-Saadoon. 1995. On occurrence of *Monosporascus eutypoides* in arid region of Iraq. *Basrah Journal of Science* **12** (in press).

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MYCOTAXON

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LITTER HYPHOMYCETES FROM LA GOMERA (CANARIES)

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ABSTRACT

Anungitopsis gomerensis *anam. sp. nov.*, recognized by its catenate, obovoid, 1-septate conidia (with cells of different colour), and ***Triposporium verruculosum*** *anam. sp. nov.*, distinguished by its dark brown to brown stauroconidia, with 3-4 arms and verrucose wall, are described and illustrated. A key to species of ***Anungitopsis*** is given and 25 other conidial fungi are newly reported for Spain.

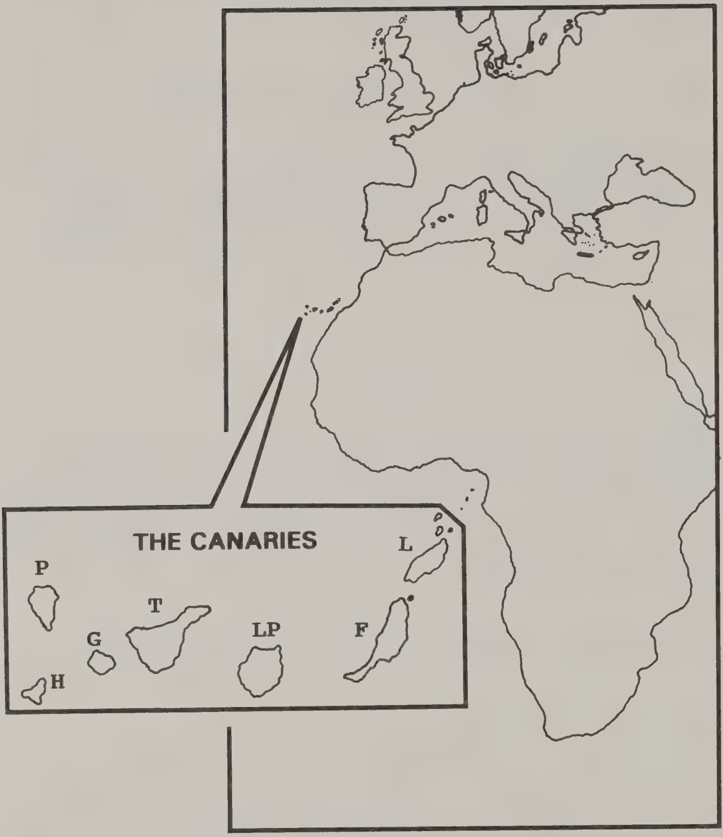
Key words: ***Anungitopsis***, ***Triposporium***, hyphomycetes, Canaries.

RESUMEN

Se describe e ilustra ***Anungitopsis gomerensis*** *anam. sp. nov.*, caracterizada por sus conidios formando cadenas, obovoides y con 1 septo (con células de diferente color), y ***Triposporium verruculosum*** *anam. sp. nov.*, la cual se distingue por sus estauroconidios de color pardo a pardo oscuro, con 3-4 ramificaciones y de pared verrugosa. Se propone una clave dicotómica para las especies de ***Anungitopsis*** y, además, se incluyen 25 nuevas citas para el catálogo micológico español.

Palabras clave: ***Anungitopsis***, ***Triposporium***, hifomicetes, Islas Canarias.

The material studied here was collected in the *Parque de Garajonay* from *La Gomera* island in the Canaries, Spain (Fig. 1).


THE CANARIES
P
T
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H

Fig. 1. The Canaries. F, Fuerteventura. G, La Gomera. H, Hierro. L, Lanzarote. LP, Las Palmas. P, La Palma. T, Tenerife.

Anungitopsis gomerensis Castañeda, Gené *et* Guarro *anam. sp. nov.*

Etym.: referring to the source, La Gomera island. **Fig. 2; Fig. 3 a,b**

Ad fungos conidiales, hyphomycetes pertinens. Coloniae pilosae, effusae, hypophyllae, nigrae. Mycelium partim superficiale et partim in substrato immersum, ex hyphis septatis, ramosis, laevibus, brunneis, 1-1.5 µm diam. compositum. Conidiophora conspicua, mononematosa, erecta, recta vel flexuosa, nodosa ad apicem, eramosa, cylindrica, 6-10-septata, levia, atrobrunnea ad basim, pallide brunnea vel brunnea ad apicem, 80-300 x 8-10 µm. Cellulae conidiogenae polyblasticae, sympodiales, terminales, interdum intercalares, integratae, dilute brunneae usque subhyalinae, denticulatae, cum denticulis conspicuis, interdum emanifestis praeditae. Conidia obovoidea, bicellularia, blastocatenata, non-ramosa, breviter formantia, levia, sicca, 8-11 x 4-5 µm, cum cellula basalis pallidissime brunnea et cellula apicalis brunnea. Teleomorphosis ignota.

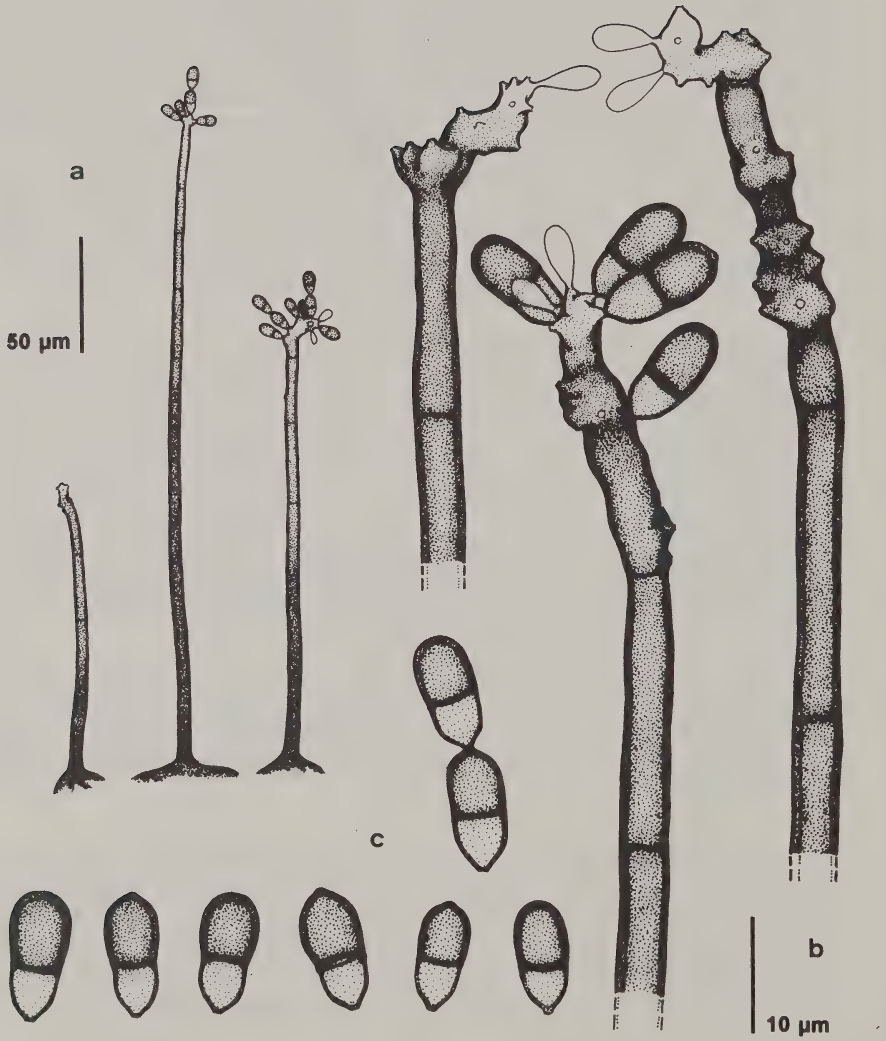
Conidial fungi, hyphomycetes. Colonies hairy, spreading, hypophyllous, black. Mycelium partly immersed and partly superficial. Hyphae septate, branched, smooth-walled, brown, 1-1.5 µm diam. Conidiophores differentiated, mononematous, erect, straight or flexuous, knotty near apex, unbranched, cylindrical, 6-10-septate, smooth-walled, dark brown at the base, pale brown to brown towards the apex, 80-300 x 8-10 µm. Conidiogenous cells polyblastic, sympodial, terminal, sometimes intercalary, integrated, pale brown to subhyaline, denticulate, with evident or inconspicuous denticles. Conidia obovoid, 1-septate, in short acropetal, unbranched chains, smooth-walled, dry, 8-11 x 4-5 µm, with pale brown basal cell and brown apical cell. Teleomorph unknown.

Holotype: INIFAT C95/16 (Habana, Cuba), on rotten fallen leaf, Parque Nacional de Garajonay, La Gomera, Canaries, Spain, leg. R.F. Castañeda and J. Guarro, 4 Jan. 1995. **Isotype:** CBS-H 5629 (Centraalbureau voor Schimmelcultures Herbarium, Netherlands). **Cultures ex type:** CBS 241.95, INIFAT C95/204-1.

Up to now the genus ***Anungitopsis*** Castañeda & Kendrick (1990) had four accepted species: ***A. speciosa*** Castañeda & Kendrick (1990) as type species, ***A. inaequiseptata*** Kendrick & Castañeda (1990), ***A. dimorphospora*** Castañeda & Kendrick (1991) and ***A. triseptata*** (Matsushima) Castañeda & Kendrick (1991). All these species are clearly differentiated from ***A. gomerensis*** by the size, shape and pigmentation of the conidia.

Key to species of **Anungitopsis**

1a. Conidia up to 2-septate 2
1b. Conidia with more than 2 septa 3


a
50 µm
c
b
10 µm

2a. Conidia 1-2-septate, clavate, colourless or subhyaline, 11-14(-19) x 1.5-2 µm, ... ***A. inaequiseptata***
2b. Conidia 1-septate, obovoid, with basal cell subhyaline and apical cell brown, 8-11 x 4-5 µm, ... ***A. gomerensis***
3a. Conidia fusiform or obovoid, usually 3-septate, central cells brown, ends subhyaline, 13-17 x 3-4.5 µm . . . . ***A. dimorphospora***
3b. Conidia cylindrical 4
4a. Conidia subhyaline or pale brown, (2-)3(-5)-septate, 15-28 x 2.5-4 µm . . . . ***A. speciosa***
4b. Conidia with brown middle cells, ends subhyaline, 3-septate, 22-33 x 4-5.5 µm . . . . ***A. triseptata***

Triposporium verruculosum Castañeda, Gené *et* Guarro *anam sp. nov.*

Etym.: referring to the verrucose conidia wall. **Fig. 3 c-e; Fig. 4**

Ad fungos conidiales, hyphomycetes pertinens. Coloniae effusae, pilosae, amphigenae, nigrae. Mycelium plerumque in substrato immersum. Hyphae septatae, ramosae, laeves, brunneae, 1-2 µm diam. Conidiophora conspicua, mononematosa, erecta, recta, cylindrica, usque 15-septata, levia, atrobrunnea ad basim, brunnea ad apicem, 120-260 x 10-15 µm, cum 1-2 proliferationibus percurrentibus circa apicem praedita. Cellulae conidiogenae monoblasticae, terminales, determinatae vel percurrentes, 10-14 x 4-4.5 µm, conico-cylindricae, leviter attenuatae, in conidiophoris incorporatae, brunneae. Conidia stellata, solitaria, acrogena, sicca, ex cellulis 3 partibus formarum composita: (a) cellula basalis obconica usque cylindrica, truncata, levia, olivacea vel brunnea, 10-12 x 4.5-5.5 µm; (b) cellula suprabasalis angularia, atrobrunnea vel nigra, verrucosa, 10-13 µm lat.; (c) 3-4 ramis divergentibus, gradatim angustatis, rotundatis ad apicem, 3-6-septatis, leviter constrictis ad septis, omnis verrucosis, in apicem laevibus, atrobrunneis ad basim, dilute brunneis ad apicem. Rami 20-30 µm long., 10-12 µm lat. ad conjunctionibus, 4-5 µm ad versus. Tunica mucosa, 4-5 µm diam. interdum circa apicem adsunt. Teleomorphosis ignota.

Conidial fungi, hyphomycetes. Colonies spreading, hairy, amphigenous, black. Mycelium mostly immersed. Hyphae septate, branched, smooth-walled, brown, 1-2 µm diam. Conidiophores differentiated, mononematous, erect, straight, cylindrical, up to 15-septate, smooth-walled, base dark brown, apex brown, 120-260 x 10-15 µm, often with 1-2 percurrent extensions near the apex. Conidiogenous cell monoblastic, terminal, determinate or percurrent, 10-14 x 4-4.5 µm, conico-cylindrical, slightly attenuate, integrated, brown. Conidia stellate, solitary, acrogenous, dry; basal cell obconical to cylindrical, truncate, smooth-walled, olivaceous or brown, 10-12 x 4.5-5.5 µm; suprabasal cell angular, dark brown or black,

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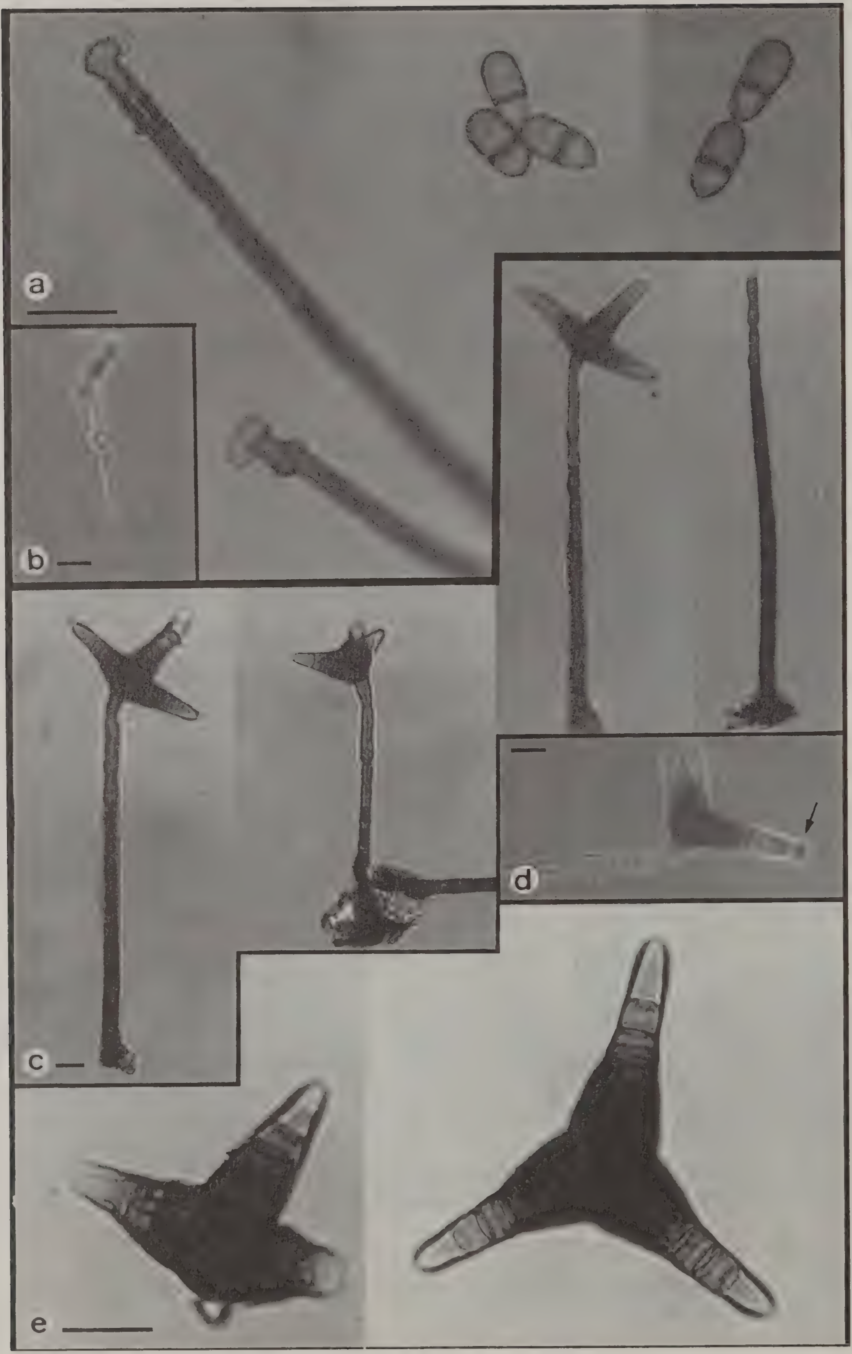
Fig. 2. ***Anungitopsis gomerensis***, INIFAT C95/16. **a**. Habitat. **b**. Apical part of the conidiophores. **c**. Conidia.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verrucose, 10-13 μm diam., from which arise 3-4 arms; arms divergent, tapering, rounded at the apex, 3-6-septate, slightly constricted at the septa, verruculose, smooth-walled at the apex, dark brown at the base, pale brown towards the apex, 20-30 μm long., 10-12 μm wide at the base to 4-5 μm near the apex, with a blob of mucilage, 4-5 μm diam., often observed at the apices. Teleomorph unknown.

Holotype: INIFAT C95/8 (Habana, Cuba), on rotten fallen leaf of *Laurus* sp., Parque Nacional de Garajonay, La Gomera, Canaries, Spain, leg. R.F. Castañeda and J. Guarro, 4 Jan. 1995. **Isotypes:** MUCL 39136 (Mycothèque de l'Université Catholique de Louvain, Louvain-la-Neuve, Belgium), CBS-H 5625 (Centraalbureau voor Schimmelcultures Herbarium, Netherlands).

Triposporium elegans Corda (Ellis, 1971) and ***T. lambdaseptatum*** (Matsush.) Kuthub. & Nawawi (1991) are comparable with ***T. verruculosum*** in shape and pigmentation of the conidia, but both have the conidial arms smooth-walled and longer. ***T. novoguineense*** Rifai (1972) was considered a synonym of ***T. lambdaseptatum*** by Kuthubutheen and Nawawi (1991). Other previously described species such as ***T. sarcinula*** Sacc. (1886), ***T. batistae*** J.L. Crane & Dumont (1975), and ***T. foliicola*** Gamundí, Aramb. & Giaiotti (1977) do not resemble ***T. verruculosum***. Hughes (1958) listed several species which were excluded from ***Triposporium*** Corda or redisposed into ***Actinocladium*** Ehrenb. and ***Ceratosporium*** Schwein. A key to the species of this genus is not given in this paper because a revision of herbarium material is needed for some species.

Conidial fungi first recorded for Spain

Anungitea fragilis B. Sutton, *CMI Mycol. Pap.* 132:10, 1973. **Fig. 5 a**

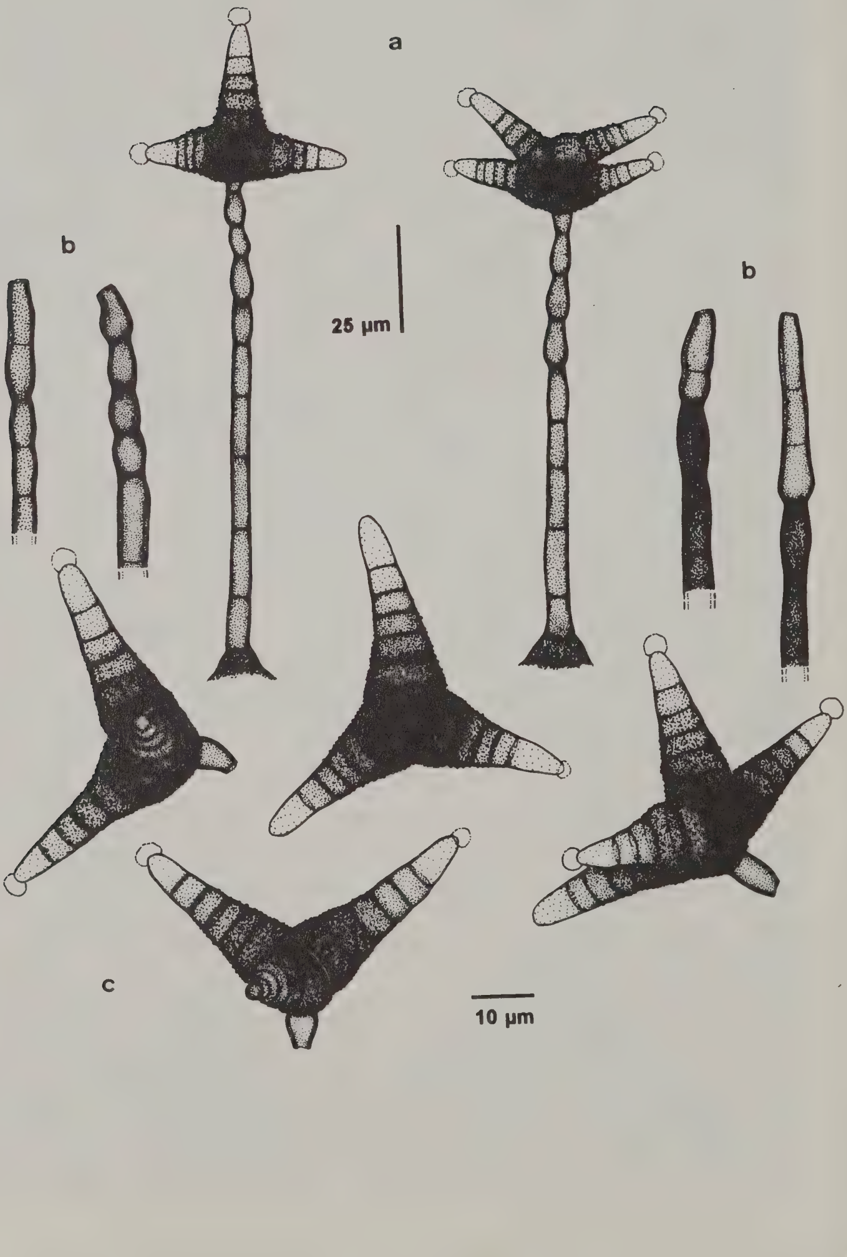
Specimen examined: INIFAT C95/171 on rotten fallen leaf, La Gomera, Canaries, Spain, leg. R.F. Castañeda, 4 Jan. 1995.

Anungitea rhabdospora P.M. Kirk, *Trans. Br. mycol. Soc.* 80:451, 1983.

Specimen examined: INIFAT C95/3-2, on dead fallen leaf of *Laurus* sp., La Gomera, Canaries, Spain, leg. R.F. Castañeda, 5 Jan. 1995.

Anungitopsis triseptata (Matsush.) Castañeda & Kendrick, *Univ. Waterloo Biol. Ser.* 35:12, 1991. **Fig. 5 e**

Fig. 3. a,b. ***Anungitopsis gomerensis***, INIFAT C95/16. Part of the conidiophores and conidia; a,b. bar = 10μm. **c-e.** ***Triposporium verruculosum***, INIFAT C95/8. **c.** Conidiophores; bar = 10μm. **d.** Conidium with a blob of mucilage at the top of an arm (arrow); bar = 10μm. **e.** Conidia; bar = 10μm.


a
b
25 µm
b
c
10 µm

Specimen examined: INIFAT C95/17-1, on rotten fallen leaf, La Gomera,Canaries, Spain, leg. R.F. Castañeda, 4 Jan. 1995; INIFAT C95/28, on fallen leaf of *Juncus* sp., La Gomera, Canaries, Spain, leg. R.F. Castañeda, 5 Jan. 1995; INIFAT C95/41, on rotten fallen leaf, La Gomera, Canaries, leg. R.F. Castañeda, 4 Jan. 1995.

Ardhachandra cristaspora (Matsush.) Subram. & Sudha, *Can. J. Bot.* 56:729, 1979. **Fig. 5 b**

Specimen examined: INIFAT C95/50-1, on rotten fallen leaf, La Gomera, Canaries, Spain, leg. R.F. Castañeda, 4 Jan. 1995.

Beltraniella pirozynskii P.M. Kirk, *Trans. Br. mycol. Soc.* 77:457, 1981.

Specimen examined: INIFAT C95/2-1, on decaying leaf of *Laurus* sp., La Gomera, Canaries, Spain, leg. R.F. Castañeda, 4 Jan. 1995; INIFAT C95/42, on rotten fallen leaf, La Gomera, Canaries, leg. R.F. Castañeda, 5 Jan. 1995.

Calcarisporium arbuscula Preuss, *Linnaea* 24:124, 1851.

Specimen examined: INIFAT C95/32, on rotten fallen leaf, La Gomera, Canaries, Spain, leg. R.F. Castañeda, 4 Jan. 1995.

Note: Colonies on oat meal-agar at 25°C, farinose, flat, white-yellow reverse yellow stains. Conidia obovoid, dry, smooth-walled, 4-7 x 1.5-2.5 μm.

Cylindrosympodium variabile (de Hoog) Kendrick et Castañeda, *Univ. Waterloo Biol. Ser.* 32:10, 1990.

Specimen examined: INIFAT C95/5, on rotten fallen leaf, La Gomera, Canaries, Spain, leg. R.F. Castañeda, 4 Jan. 1995.

Chaetopsina fulva Rambelli, *Atti Accad. Sci. Ist. Bologna Rc. Ser.* 11, 3:5, 1956.

Specimen examined: INIFAT C95/6-3, on rotten fallen leaf, La Gomera, Canaries, Spain, leg. R.F. Castañeda, 4 Jan. 1995.

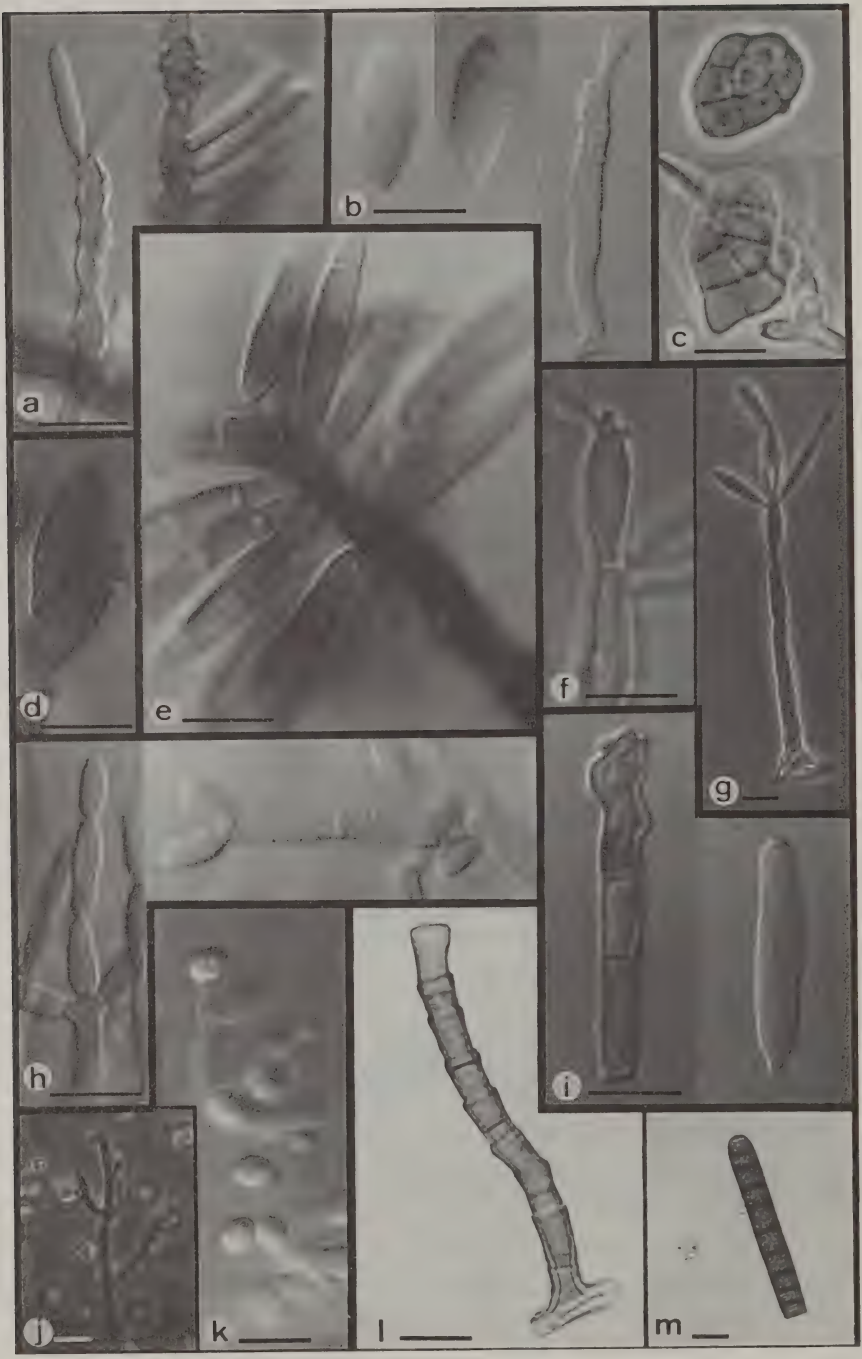
Dactylaria obtriangularia Matsush., *Icon. microf. a Matsushima lect.* Kobe: 51, 1975.

Specimen examined: INIFAT C95/2-2, on decaying leaf of *Laurus* sp., La Gomera, Canaries, Spain, leg. R.F. Castañeda, 4 Jan. 1995.

Dictyochaeta querna P.M. Kirk, *Trans. Br. mycol. Soc.* 81:58, 1982.

Specimen examined: INIFAT C95/11, on rotten fallen leaf, La Gomera, Canaries, Spain, leg. R.F. Castañeda, 5 Jan. 1995.

Fig. 4. ***Triposporium verruculosum***, INIFAT C95/8. **a.** Conidiophores. **b.** Apical part of the conidiophores. **c.** Conidia.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Endophragmiella lauri P.M. Kirk, *Trans. Br. mycol. Soc.* 78:295, 1980.

Specimens examined: INIFAT C95/7, on decaying leaf of *Laurus* sp., La Gomera, Canaries, Spain, leg. R.F. Castañeda, 4 Jan. 1995; INIFAT C95/29-2, on rotten fallen leaf, La Gomera, Canaries, Spain, leg. R.F. Castañeda. 4 Jan. 1995.

Helicosporium anam. of ***Tubeufia helicomyces*** Höhnel, *Sber. Akad. Wiss. Wien* 118:1477, 1909.

Specimen examined: INIFAT C95/33, on rotten fallen leaf, La Gomera, Canaries, Spain, leg. R.F. Castañeda, 4 Jan. 1995.

Kamatia indica V.G. Rao & Subhedar, *Trans. Br. mycol. Soc.* 66:541, 1976. **Fig. 5 c**

Specimen examined: INIFAT C95/20, on rotten fallen leaf, La Gomera, Canaries, Spain, leg. R.F. Castañeda, 4 Jan. 1995.

Nakataea fusispora (Matsush.) Matsush., *Icon. microf. a Matsushima lect.* Kobe: 100, 1975. **Fig. 5 d**

Specimen examined: INIFAT C95/47, on dead fallen leaf of *Laurus canariensis*, La Gomera, Canaries, Spain, leg. R.F. Castañeda, 5 Jan. 1995.

Parapleurotheciopsis ilicina P.M. Kirk, *Trans. Br. mycol. Soc.* 78:65, 1982. **Fig. 5 f,g**

Specimen examined: INIFAT C95/3, on dead fallen leaf of *Laurus* sp., La Gomera, Canaries, Spain, leg. R.F. Castañeda, 4 Jan. 1995.

Parapleurotheciopsis inaequiseptata (Matsush.) P.M. Kirk, *Trans. Br. mycol. Soc.* 78:65, 1982. **Fig. 5 i**

Specimens examined: INIFAT C95/15, on rotten fallen leaf, La Gomera, Canaries, Spain, leg. R.F. Castañeda, 4 Jan. 1995; INIFAT C95/36-1, on leaf litter, La Gomera, Canaries, Spain, leg. R.F. Castañeda, 5 Jan. 1995.

Periconiella ilicis P.M. Kirk, *Trans. Br. mycol. Soc.* 80:458, 1983. **Fig. 5 h**

Specimens examined: INIFAT C95/10, on fallen twig, La Gomera, Canaries,

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Fig. 5. **a.** ***Anungitea fragilis***, C95/17; bar = 10μm. **b.** ***Ardhachandra cristaspora***, C95/50-1; bar = 10μm. **c.** ***Kamatia indica***, C95/20; bar = 10μm. **d.** ***Nakataea fusispora***, C95/47; bar = 10μm. **e.** ***Anungitopsis triseptata***, C95/17-1; bar = 10μm. **f, g.** ***Parapleurotheciopsis ilicina***, C95/3; bar = 10μm. **h.** ***Periconiella ilicis***, C95/19; bar = 10μm. **i.** ***Parapleurotheciopsis inaequiseptata***, C95/15; bar = 10μm. **j,k.** ***Sesquicillium candelabrum***, C95/45; bar = 10μm. **l,m.** ***Sporidesmium goidanichii***, C95/46; bar = 10μm.

Spain, leg. R.F. Castañeda, 5 Jan. 1995; INIFAT C95/19, on rotten fallen leaf, La Gomera, Canaries, leg. R.F. Castañeda, 4 Jan. 1995.

Polyscytalum gracilisporum (Matsush.) B. Sutton & Hodges, *Nova Hedwigia* 28:488, 1976.

Specimen examined: INIFAT, C95/2, on dead fallen leaf of *Laurus* sp., La Gomera, Canaries, Spain, leg. R.F. Castañeda, 4 Jan. 1995.

Scolecobasidium tshamytschae (Doty & D.W. Slater) McGinnis & Ajello, *Trans. Br. mycol. Soc.* 63:202, 1974.

Specimen examined: INIFAT C95/29, on rotten fallen leaf, La Gomera, Canaries, Spain, leg. R.F. Castañeda, 5 Jan. 1995.

Sesquicillium candelabrum (Bonord.) W. Gams, *Acta bot. neerl.* 17:457, 1968. **Fig. 5 j,k**

Specimen examined: INIFAT C94/45, from dead insect on dead fallen leaf of unidentified plant, La Gomera, Canaries, Spain, leg. R.F. Castañeda, 5 Jan. 1995.

Sporidesmiella hyalosperma (Corda) P.M. Kirk var. ***hyalosperma*** P.M. Kirk, *Trans. Br. mycol. Soc.* 79:481, 1982.

Specimen examined: INIFAT C95/37, on dead fallen leaf of unidentified Poaceae, La Gomera, Canaries, Spain, leg. R.F. Castañeda. 4 Jan. 1995.

Sporidesmiella parva (M.B. Ellis) P.M. Kirk. *Trans. Br. mycol Soc.* 79:486, 1982.

Specimen examined: INIFAT C95/57, on fallen twig, La Gomera, Canaries, Spain, leg. R.F. Castañeda. 4 Jan. 1995.

Sporidesmium goidanichii (Rambelli) S. Hughes. *N. Z. J. Bot.* 17:162, 1979. **Fig. 5 l,m**

Specimen examined: INIFAT C95/46, on dead fallen leaves of *Laurus canariensis*, La Gomera, Canaries, Spain, leg. R.F. Castañeda, 5 Jan. 1995.

Sporidesmium leptosporum (Sacc. & Roum.) S. Hughes, *Can. J. Bot.* 36:808, 1958.

Specimen examined: INIFAT C95/14, on fallen bark of *Laurus* sp., La Gomera, Canaries, Spain, leg. R.F. Castañeda, 4 Jan. 1995.

Thozetella havensis Castañeda, *Rev. Jard. Bot. Nac.* 5:69, 1984.

Specimen examined: INIFAT C95/13, on rotten fallen leaf, La Gomera, Canaries, Spain, leg. R.F. Castañeda, 4 Jan. 1995.

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RHIZOPUS SCHIPPERAE, SP. NOV., A NEW AGENT OF ZYGOMYCOSIS

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ABSTRACT

A new species of *Rhizopus, R. schipperae* sp. nov., is described in this report. The isolate was recovered from the bronchial wash and lung specimens from a patient with myeloma. Typical hyphae suggestive of zygomycosis (mucormycosis) were observed in both specimens. Morphologically, the species belongs to the *R. microsporus* complex and is closest to *R. microsporus* var. *microsporus,* although it shares some characteristics of *R. caespitosus* of that complex and *Amylomyces rouxii.* However, there are sufficient differences from all these taxa to warrant creating a new taxon. Distinguishing characteristics include the production of sporangia on a limited range of media, best on Czapek, where it produces up to 10 sporangiophores arising from a cluster of rhizoids. Only chlamydospores and hyphae were produced on all the other mycological media tested. Growth occurs on potato-dextrose agar at 45°C but not at 48°-50°C, optimal development was observed at 30-35°C.

INTRODUCTION

Two cultures from a patient with myeloma were received in the laboratory for identification. One specimen, (UTHSC 94-376), was from bronchial wash, the other, (UTHSC 94-538), from the right lower lobe of the lung. Both cytology and pathology laboratories reported mucormycosis.

Initial microscopic observation of the culture from the bronchial wash on potato flakes agar revealed morphology, based on size, suggestive of the *Rhizopus microsporus* complex, Schipper and Stalpers (1984). However, this sporulation was absent in the culture from the lung; only abundant subglobose to oval, thin-and thick-walled chlamydospore-like structures were observed, most apparently devoid of cytoplasm. These chlamydospore-like structures, present in both isolates, persisted on subculture, but the initial *Rhizopus*-type of sporulation observed in the culture from bronchial wash disappeared.

This communication describes our efforts to identify these cultures, our conclusion that they represent a new species, and a description of that species which we name *Rhizopus schipperae.*

MATERIAL AND METHODS

1. Culture Media

Subcultures were made on a variety of commercial and home-made media in an attempt to obtain characteristic sporulation sufficient for identification. This included: potato-dextrose agar (Remel, Lenexa, Kansas), Czapek agar (Remel) formula of Thom and Church, Sabouraud dextrose agar with yeast extract (Remel), trichophyton agars (Remel), birdseed agar (Remel), yeast extract agar (YEA), malt extract agar, oatmeal agar, potato-carrot agar, lactrimel, YPSS, synthetic mucor agar (SMA), and agar flotation blocks in sterile distilled water with 0.1% yeast extract, Padhye and Ajello (1988), or with a variety of grass and vegetable material added. All cultures were incubated at 30°C under conditions of alternating light and dark. A brain-heart infusion agar tube (Becton Dickinson Microbiology Systems, Cockeysville, Maryland) was incubated at 37°C.

2. Temperature

Studies on temperature tolerance were conducted on potato-dextrose agar (PDA) at 23°C, 30°C, 40°C, 42°C, 45°C, 48°C, and 50°C; growth and sporulation on Czapek agar at 23°C, 30°C, 37°C, 40°C, 42°C, and 45°C.

3. Mating Studies

Each of the clinical isolates were paired on PDA and YEA with ATCC cultures of *R. microsporus* var. *microsporus* and *Amylomyces rouxii.* The paired ATCC cultures and the cultures paired with itself served as positive and negative controls, respectively. Incubation of the paired cultures took place in the dark at 30°C.

4. Description

Grouping of the sporangiophores was observed under the dissecting microscope and in teased mount preparations. Sporangia and accompanying structures were examined on cultures incubated on Czapek and SMA for 5 days at 25-30°C under alternating conditions of light and dark. Microscopic structures were measured in teased preparations in distilled water.

RESULTS

Sporulation suggestive of the *R. microsporus* complex was obtained only on Czapek, potato-carrot agar and SMA. Good growth, chlamydospores and hyphae were observed on all the other media as well.

Growth occurred on PDA up to 45°C, but was absent at 48°C or at 50°C. Comparable growth on Czapek agar was observed up to 42°C, however, growth at 45°C was very restricted. Sporulation on Czapek was present at 37°C, although very sparse at the higher temperature. Optimum growth and characteristic sporulation were best achieved at 30°C on the Czapek agar.

Nine single sporangiospores obtained from both cultures on Czapek's agar were each transferred to a PDA tube to ascertain purity of the cultures. The resulting growth in each PDA tube was similar and only chlamydospores were observed.

No zygospores resulted in pairings with any of the *R. microsporus* var. *microsporus* and with the *A. rouxii* cultures, or in cultures paired with themselves. The crosses between all the (+) and (–) isolates of *R. microsporus* var. *microsporus* including ATCC 56019 produced abundant zygospores on both PDA and YEA.

DISCUSSION AND DESCRIPTION

Our isolates most closely resemble *R. microsporus* var. *microsporus* based on temperature tolerance, similar appearance of the columellae, similar size of sporangia, sporangiophores and the striate sporangiospores (Schipper 1984, Schipper and Samson 1994). They differ by the formation of clusters of sporangiophores, up to 10 arising from a bundle of rhizoids [and in this respect resembles *R. caespitosus* Schipper & Samson (1994)], by the presence of abundant, large, mostly round, terminal and intercalary chlamydospores on all media examined, the limited range of media for the development of sporangia and colony color on PDA (Table 1). The presence of abundant chlamydospores suggested *A. rouxii,* Ellis, Rhodes & Hesseltine

(1976). However, they differed from *A. rouxii* in several major characteristics (Table 3), i.e., *A rouxii* grows very sparsely on Czapek, has longer sporangiophores (up to 2.5 mm) which are single and not clustered, has larger and abortive sporangia and sporangiospores, rare rhizoids (we observed none) and does not grow on PDA at 45°C. The clustering of the sporangiophores on our isolates (up to 10) resembles the description of *R. caespitosus,* Schipper & Samson (1994) but differs by the appearance of the sporangia, sporangiopores and maximum temperature of growth (Table 3).

Our two clinical isolates from the same patient, UTHSC 94-376 from bronchial wash and UTHSC 94-538 from the lung, are similar in all aspects studied and are considered as one species. It appears to belong to the *R. microsporus* complex, closest to var. *microsporus,* and the newly described *R. caespitosus* Schipper & Samson (1994), but is distinct enough to warrant the description of a new taxon, *R. schipperae,* in honor of Dr M.A.A. Schipper.

Latin description

Rhizopus schipperae Weitzman, McGough, Rinaldi & Della-Latta, sp. nov. - Figs 1-8.

Coloniae in agaro Czapekii ad 8 cm diam post 4 dies 30°C, griseo-albae, diffusae, tenues, floccosae; sporangiophora brunnea, (singula vel) ad decena aggregata oriunda e rhizoideis, 100-460 x 5-15 µm; sporangia griseo-atra, ad 80 µm diametro; columellae subglobosae vel subglobosae-conicae, hyalinae vel dilute bubalinae; sporangiosporae subglobosae vel ovales, inconspicue striatae, siccae magis striatae et angulares, ad 5.8 µm diametro; rhizoidea simplicia, raro ramosa, hyalina vel brunnra, ad 100 µm longa; 23-37°C; crescit et sporulat chlamydosporae copiosae, terminales vel intercalares, tenui-vel fere crassitunicatae, (0.5-1 µm), subglobosae, ovales vel ellipsoideae, ad 20 µm diametro. Coloniae in agaro PDA dicto eburneae, floccosae, tantum chlamydosporas nec sporangia formantes; 45°C crescere potest. Zygosporae ignotae. Typus vivus CBS 138.95 = ATCC 96514, holotypus exsiccatus BPI 80281, in Beltsville, Maryland, praeservatus, e pulmone humano isolatus a D. McGough, Texas.

Colonies on Czapek agar attaining a diameter of 8 cm within 4 days at 30°C; growth up to 40°-42°C, very restricted at 45°C, optimum at 30°C; greyish white, diffuse, thin, flocculose; sporangiophores brown, often septate, aggregated in groups up to 10 from a nest of rhizoids, singly or in pairs on stolons, 100-460 µm in length 5-15 µm wide; sporangia greyish-black (taupe) up to 80 µm diam; columellae subglobose to subglobose-conical, hyaline to light tan; sporangiospores subglobose to oval, faintly striated in water, angular, oval and distinctly striated when dry, 5.8 cm - 6.8 x 4.8 - 5.8 µm. Rhizoids simple, rarely branched, hyaline or light brown occasionally septate, 37 µm - 100 µm 1; chlamydospores abundant, terminal or intercalary, thin-to moderately (0.5-1 µm), thick-walled globose, oval to ellipsoidal, up to 20 µm diam; colonies on potato-dextrose agar at 30°C attaining a diam of 8cm within 4 days, ivory, floccose; chlamydospores only, sporangia absent; good growth 23°C to 45°C; optimum at 30°-35°C.

Specimens examined: UTHSC 94-376, isolated from bronchial wash, and UTHSC 94-538, type isolate, (ATCC 96514; CBS 138.95) isolated from human lung, by D. McGough, Fungus Testing Lab, San Antonio, Texas, USA.

Specimens of other taxa examined: *Rhizopus microsporus:* var. *microsporus* ATCC 52813 (CBS 699.68) (+), ATCC 52814 (CBS 700.68) (–), both from A. Milko, forest soil, Ukraine; ATCC 56019 (–), Z. Lee AS 3.2895 *R. chlamydosporus* (–). *Amylomyces rouxii,* neotype (NRRL 5866 CBS 438.76) sweet fermented glutinous rice.

Table 1. Differences between *R. schipperae* and *R. microsporus* var. *microsporus.*

	R. schipperae	***R. microsporus* var. *microsporus***
Grouping of sporangiopores	clusters, up to 10	usually single, up to three
Chlamydospores	numerous on all media	varying with the isolate, rare to numerous
Formation of sporangia	on special media	on routine media
Color colony on PDA	ivory	pale (brownish grey)
Zygospores	none with + and – strains of *R. microsporus* var. *microsporus*	easily obtained, present in crosses between + and – strains

Table 2. Differences between *R. schipperae* and *A. rouxii*

	R. schipperae	***A. rouxii***
Length of sporangiophores	short, up to 460 µm	long, up to 2.5 mm
Grouping of sporangiophores	usually in clusters	usually single
Rhizoids	abundant and well developed	rare
Sporangia	normal	abortive
Growth on PDA at 45°C	+	–
Growth and sporulation on Czapek	+	±

Table 3. Differences between *R. schipperae* and *R. caespitosus*

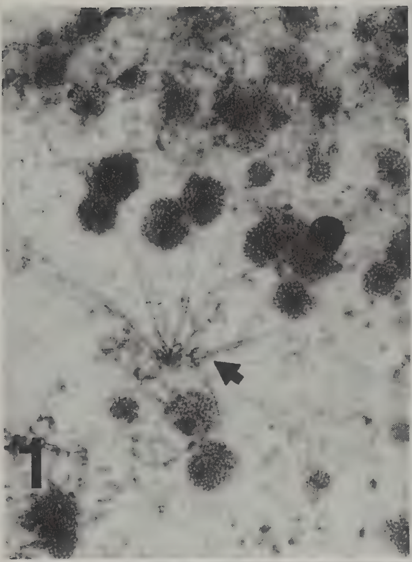
	R. schipperae	***R. caespitosus***
Sporangia	globose	long, ellipsoidal
Sporangiospores	striated	smooth
Growth at 50°C	–	+

ACKNOWLEDGMENTS

The authors wish to express their appreciation to Dr. Walter Gams for reviewing the manuscript and providing the Latin diagnosis, and Dr. A.A. Padhye for preparing the desiccated specimens.

FIGURES

Figs. 1-4. *Rhizopus schipperae,* primary isolation on potato flakes agar at 30°C. Fig. 1. Isolate UTHSC 94-376, note grouping of 8 short sporangiophores (arrow) with globose sporangia, x 229. Fig. 2. Isolate UTHSC 94-538 chlamydospores, x 229. Figs. 3-4. Chlamydospores, thin-and thick-walled, terminal and intercalary, empty and with cytoplasm, x 916. Figs. 5-8. *Rhizopus schipperae,* Czapek agar, 30°C. Fig. 5. Sporangium x 916. Fig. 6. Sporangiospores, faintly striated, lactophenol, x 2290. Fig. 7. Sporangiophores arising from rhizoids in clusters of 8-10, x 229. Fig. 8. Clusters of sporangiophores with columellae, lactophenol blue, x 916.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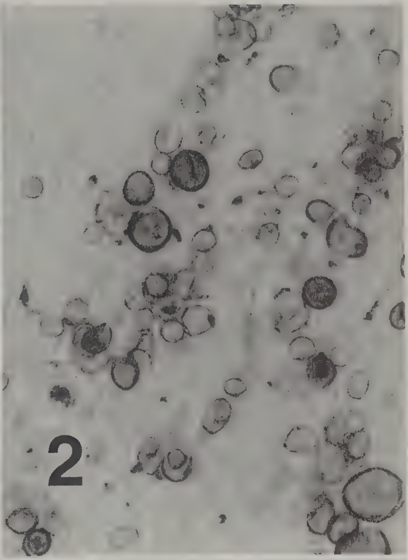
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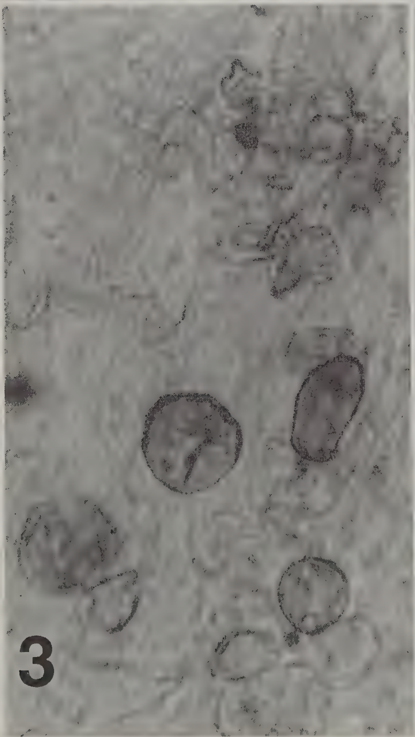
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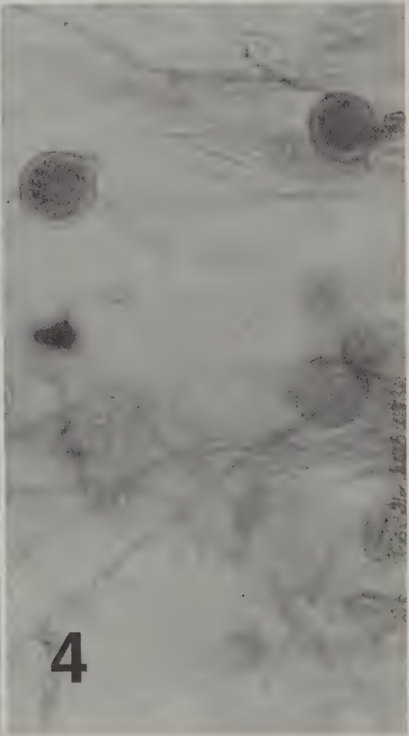
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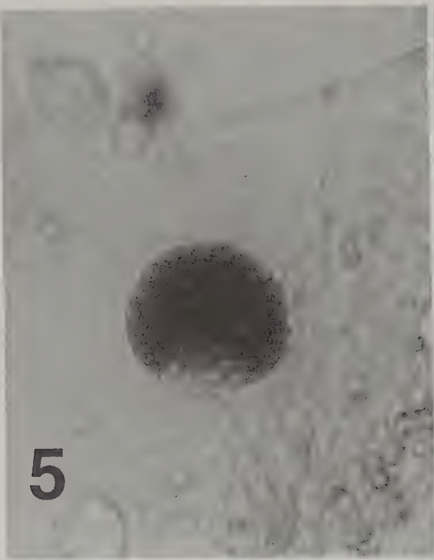
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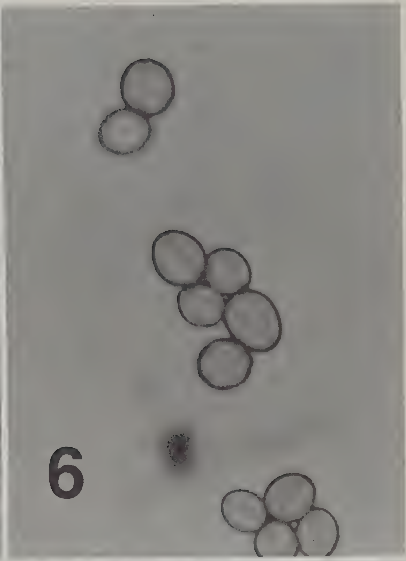
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CIBORIA CISTOPHILA SP. NOV., A LEAF-INHABITING CISTOPHILOUS MEMBER OF THE SCLEROTINIACEAE

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SUMMARY

The authors describe ***Ciboria cistophila*** as new to science. Apart from its remarkable habitat on dead leaves of ***Cistus laurifolius*** and ***C. ladanifer***, it is characterized by the small size of the apothecia, especially the substipitate habit, the large asci and ascospores, with the latter becoming septate at late maturity, occasionally producing polar "microconidia".

RESUMEN

Los autores describen ***Ciboria cistophila*** como nueva para la ciencia. Además de su peculiar hábitat, sobre hojas muertas de ***Cistus laurifolius*** y ***C. ladanifer***, el pequeño tamaño de los apotecios, su porte subestipitado, los grandes ascos y ascósporas, además del caracter septado de estas últimas y la ocasional producción de "microconidios" en uno o ambos polos, cuando maduras, caracterizan a esta especie.

Key Words: Sclerotiniaceae, ***Ciboria, Cistus,*** Spain.

MATERIALS & METHODS

Methods are in accordance with those described by the authors in GALÁN & al. (1994). Measurements were made in water, using fresh apothecia, but also in "lethal" media such as Melzer's reagent, Lugol's solution, KOH and congo red. Apothecial colours follow KORNERUP & WANSCHER (1967). In addition, mass ascospore cultures were obtained on PDA slopes from apothecia, which subsequently developed on leaves collected at two sites by the third author, and were later subcultured in 28 ml McCartney phials for further study. The culture media was self-prepared, using the following formula: strained water from 300 g of peeled potatoes, sliced and boiled in 1000 ml of water until soft, to which was added 20 g agar and 20 g dextrose, boiled until agar dissolved with water added to revert to 1000 ml and sterilized in a domestic pressure-cooker at 6.8 kg per cm^2 for 20 min. PDA sections from an isotype and the other collection were cut on an MSE freezing microtome and examined in erythrosin B in 10% ammonia, lactophenol cotton blue, Hoyer's Medium, Melzer and water.

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The holotype specimen is deposited in Herbarium AH (Dept. of Plant Biology, University of Alcalá de Henares) with isotypes distributed to CUP and the private herbarium J.T.P., whilst a subculture of an isolate from the holotype is deposited in CBS.

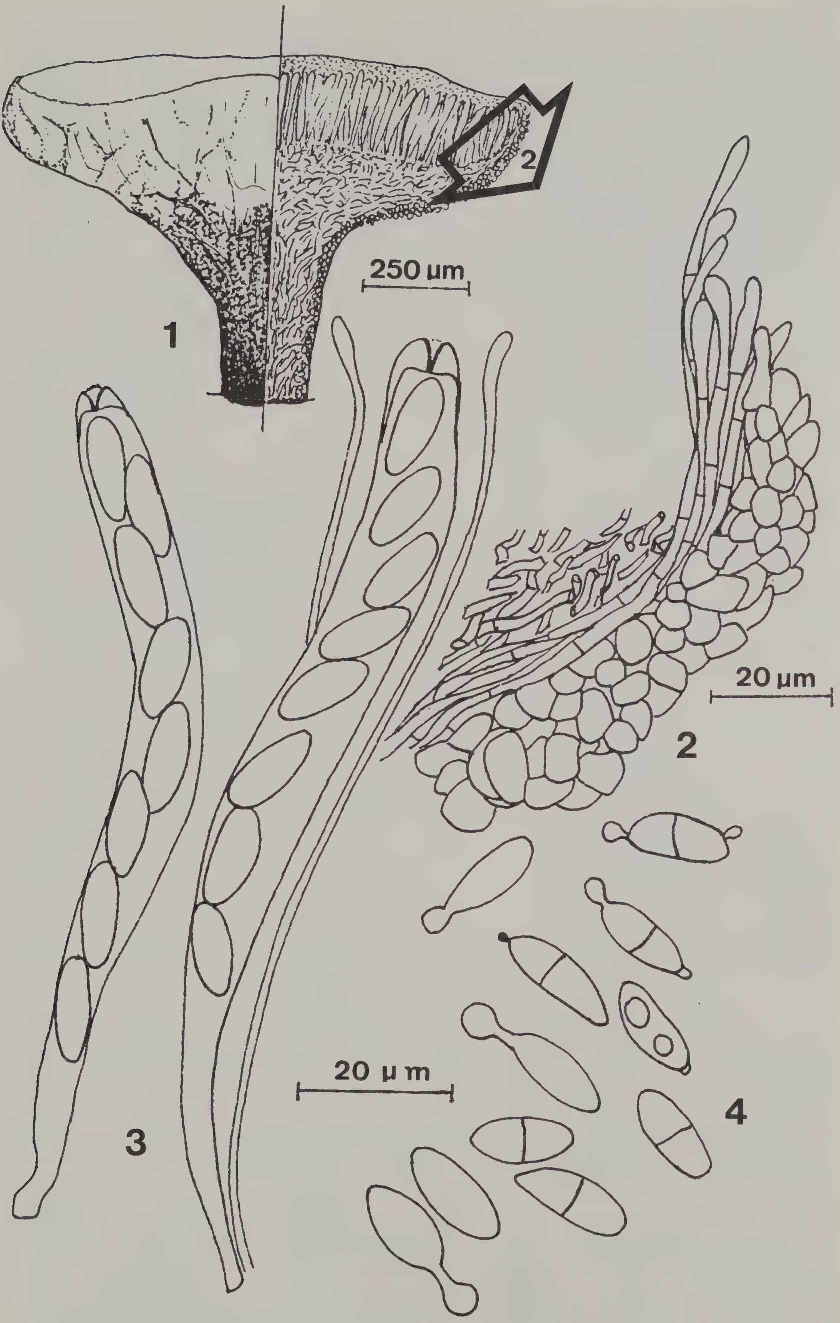
DESCRIPTION

Ciboria cistophila R. Galán, Raitv. & J. T. Palmer sp. nova (**Figs. 1-13**)

Stroma *inconspicuum.* ***Apothecia*** *solitaria, breviter stipitata, cupulata vel applanata, extus brunnea, hymenio griseo, 0.5-1.8 mm in diametro.* ***Excipulum ectale*** *ex textura globulosa ad textura angularis compositur, cellulis subcrassiter brunneotunicatis.* ***Medullare excipulum*** *ex textura intricata compositur.* ***Subhymenium*** *nulla.* ***Asci*** *cylindracei, uncinati, octospori, poro iodo coerulescentia, 120-160 x 10-13.6 µm.* ***Sporae*** *uniseriatae, late ellipsoideae, primo biguttulatae, dein uniseptati, 13-16(-18.4) x (4-)5-6.5(-7.2) µm.* ***Paraphyses*** *cylindraceae, 1.5-2 µm in diametro, apicibus subclavatis, 2.5-4 µm in diametro.*

Holotypus: *ad folium caducum* ***Cisti laurifolii***, Anquela del Ducado, Guadalajara, *Hispania*, 02.03.95, R. Galán, M. Lizárraga & J. T. Palmer *legerunt* (AH 6945). **Isotypi** in CUP 63581 et J.T.P. 4871 cum subcultura in PDA in CBS 773.95.

Figs. 1-4: ***Ciboria cistophila.*** **1.** Apothecium in external view (left half) and in vertical section (right half); **2.** Vertical section of margin; **3.** Asci and paraphyses; **4.** Ascospores simple, biguttulate, septate or producing "microconidia" (AH 6864).


250 µm
20 µm
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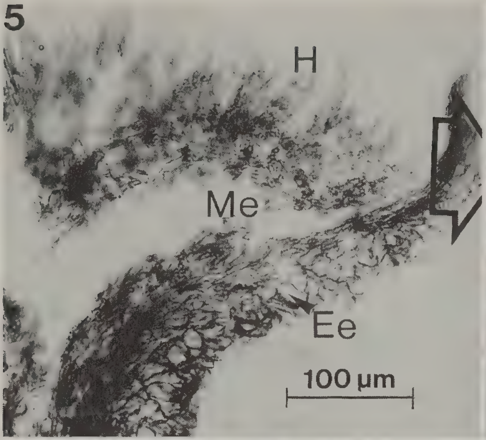
Stroma inconspicuous. **Apothecia** solitary, sometimes several, short-stipitate. **Disc** shallowly cupulate to almost plane, light brownish to greyish orange or brownish red, drying grey, up to 1.8 mm diam. **Receptacle** brown, smooth to minutely downy above. **Stipe** obconical, equalling disc diam. or shorter, dark brown, completely black at the base. **Ectal excipulum** composed of textura globulosa to textura angularis, individual cells 7-16 (-20) µm in diam., tightly packed, with moderately thick (x 0.8 µm) olivaceous brown walls, sometimes with flask-shaped hairs on the surface. **Medullary excipulum** formed of textura intricata, hyphae dark brown, 2-6 µm in diam., loosely arranged in the central part of the apothecium but more or less parallel in the flanks. **Asci** arising from croziers, cylindrical with a long slender stipe, 8-spored, ascus pore strongly blue in Lugol and Melzer, 120-160 x (8-) 10-13.6 µm. **Spores** uniseriate, broadly ellipsoid, longitudinally inequilateral, containing at first either numerous small guttules or two prominent large polar oil drops, becoming 1(-2)-septate in late maturity, 13-16(-18.4) x (4-)5-6.5 (-7.2) µm, subsequently producing one or two polar spherical "microconidia", 4-5 µm diam. **Paraphyses** filiform, basally branching, septate, pale brownish, 1.5- 2 µm diam. with clavate tips up to 2.5-4 µm diam. **(Figs. 1-11).**

Etymology: referring to the habitat on **Cistus** leaves.

Specimens examined: On leaves of ***Cistus laurifolius*** L., Anquela del Ducado, 1,200 m.a.s.l., Guadalajara, Spain, 14.03.1994, R. Galán & A. Raitviir, a single apothecium, (AH 6864; Ibidem, 02.03.1995, R. Galán, M. Lizárraga & J. T. Palmer (AH 6945, holotype; isotypes in CUP 63518 and J.T.P. 4871 with subculture on PDA in CBS 773.95) and ***Cistus ladanifer*** L., Navalvillar de Ibor, 740 m.a.s.l., Cáceres, Spain, 06.03.1995, R. Galán, M. Lizárraga & J. T. Palmer (AH 6949, duplicate in J.T.P. 4872); Ermita del Humilladero, 900 m.a.s.l., Guadalupe, Cáceres, Spain, 06.03.1995, R. Galán, M. Lizárraga & J. T. Palmer (AH 6950, duplicate in J.T.P. 4873).

Figs. 5-11: ***Ciboria cistophila*.** **5 & 6.** Optical sections of apothecium at the margin (**Ee=Ectal excipulum; Me=Medullary excipulum; H=Hymenium level**); **7 & 8.** Cross section of apothecium at the flank; **9.** Ascus tip with a very typical "bilabiate" pore (arrow); **10.** Paraphyses tips; **11.** Free ascospores with some producing "microconidia". The **scale bar** on **fig.** 5 is valid for **fig.** 7; the **scale bar** on **fig.** 6 is valid for **fig.** 8, whilst the scale bar on **fig. 11** is **valid for figs.** 9 and 10. **Figs.** 5-8 are mounted in Melzer's reagent; **Figs. 9, 10 & 11** are in congo red, excluding the two spores at the bottom, right and left, which are in Lugol's solution (AH 6864).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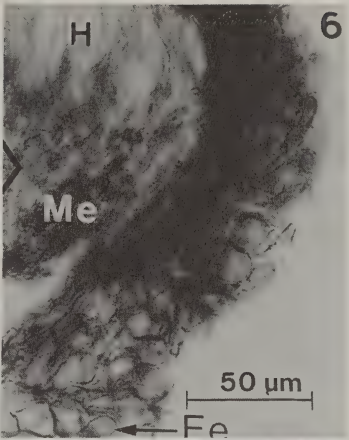
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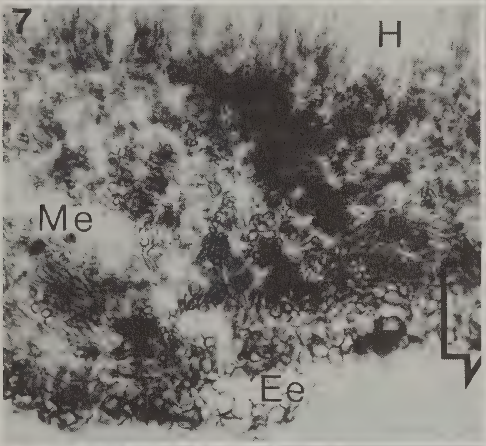
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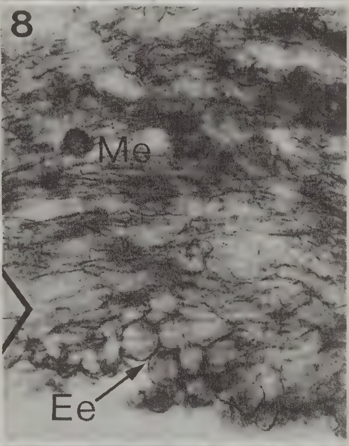
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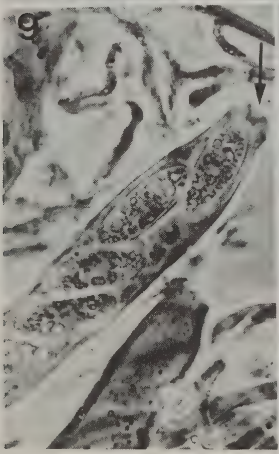
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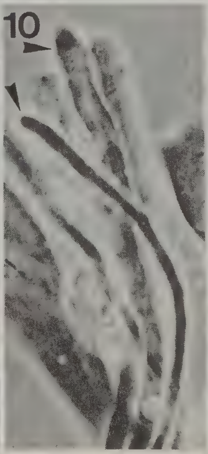
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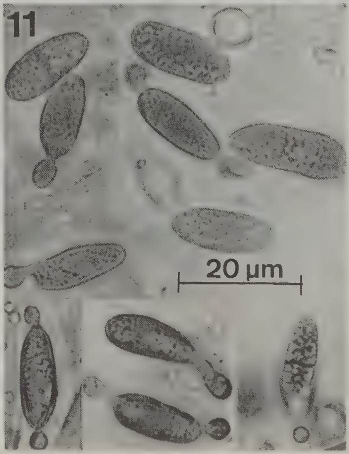
11
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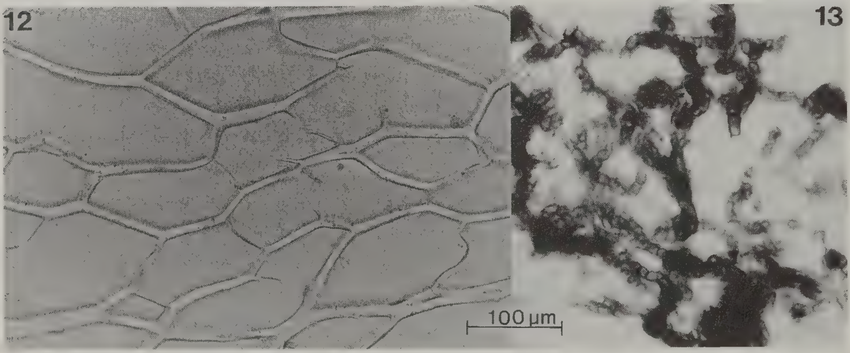
Natural culture and growth on PDA: Blackened leaves, collected by the third author at Anquela del Ducado (***Cistus laurifolius***, J.T.P. 4871 = AH 6945) and Navalvillar de Ibor (***C. ladanifer***, J.T.P. 4872 = AH 6949), were air-dried in Alcalá de Henares. Subsequently moistened with sterile water, placed in closed plastic boxes after return to England, and maintained at ambient temperatures, some additional apothecia developed after two weeks and from which culture isolates were obtained by mass ascospore discharges from single apothecia suspended overnight above PDA slopes and subcultured into McCartney phials. Both produced a surface growth of hyaline hyphae at room temperature, which radiated from the inoculated areas, darkening into ramifying dark brown patches after about ten days, which finally coalesced to produce an often undulated, shiny black stroma, which mostly completely covered the agar surface, with dark brown, branching hyphae penetrating downwards. No colour change of the agar was observed. A contaminant appeared in J.T.P. 4871 but eventually appeared to have been eliminated by subculturing.

Examination of thin razor-blade sections removed from the surface, found no sign of a rind but ramifying hyaline hyphae, which became increasingly coloured through pale to greyish brown to form islands of aggregated hyphal cells to produce localized textura epidermoidea. Microtome sections (**Fig. 13**) similarly found no evidence of a rind with the hyaline hyphae, often tortuously sinuous



Figs. 12–13: ***Ciboria cistophila***. 12. Microtome section of **Stroma** on PDA showing bright, sparsely septate hyphae forming a network. 13. Typical brown, botuliform cells from the surface area (J.T.P. 4871).

and septate, aggregating into knotlike structures of cylindrical to botuliform or reniform, sometimes inflated cells, brownish to greyish brown or darker, often 1-3-guttulate, 8-26 (-54) x 8-16(-20) µm, embedded in a gelatinous matrix which descended for ca 1 mm. Below (**Fig. 12**) was an often open reticulum of hyaline, thick-walled, much-ramified, very sparsely septate hyphae, 8-66 µm diam., to a depth of ca 2 mm in the sections studied, which appeared to be spinose in places.

Sections were examined in erythrosin B in 10% ammonia, lactophenol cotton blue, Hoyer' Medium, Melzer and water. Some slight bluing of hyphal walls was observed in lactophenol cotton blue and Melzer but the reticulum of hyaline hyphae seemed to disappear in the Melzer mounts. Occasional long, often straight, rarely anastomosing, hyaline to lightly coloured, sparsely septate, linear hyphae were observed to be stained blue in razor-blade sections from J.T.P. 4871 mounted in lactophenol cotton blue, and may have been remains of the contaminant.

Ecology: ***Cistus laurifolius***, which is distributed widely in the southern half of Peninsular Spain and extends eastward around the Mediterranean basin to Eastern Turkey and is also known from Morocco, is reported at altitudes of 400-1900 m (**DEMOLY**, 1993). The area for the type locality, Anquela del Ducado, 1,200 m.a.s.l., is known to be one of the coldest places in Spain, with Molina de Aragón, 25 km distant, having a recorded temperature of -35°C, although with minimal temperatures in winter and spring of -2.5°C and 1.7°C respectively. Ice crystals were still present on the soil and debris where the apothecia were collected on the 2nd March, 1995, which, together with the first collection of a single leaf in the same small group of bushes on the 14th March, 1994, suggests, in the absence of further finds on ***C. laurifolius*** leaves, that ***Ciboria cistophila*** may very well be a low temperature species. This view may not be contradicted by the two collections, at 740 m.a.s.l. and 900 m.a.s.l. respectively, on the 6th March, 1995, on leaves of ***Cistus ladanifer*** - which has reported altitudes of 0-1500 m and a southern distribution extending to North Africa (**DEMOLY**, 1993) - as the area was observed to be locally frosted on the following morning. Only further collections on ***C. ladanifer*** and ***C. laurifolius***, and perhaps, also, on some of the other ten species of ***Cistus*** occurring on the Iberian Peninsular, will clarify the situation.

DISCUSSION

As only a single apothecium was collected in 1994, the Guadalajara locality was revisited in 1995 when considerable searching produced many apothecia, mostly single, on leaf blades of ***Cistus laurifolius*** but with seven apothecia on the petiole and main nerve of one leaf whilst, several days later, similar apothecia were sparsely found on fallen leaves of ***Cistus ladanifer*** at two well separated sites in the Parque Natural de las Villuercas, Cáceres.

The old, fallen, mainly linear leaves of ***Cistus*** spp. are usually curled and twisted, as well as being hard and brittle, unless very moist, which makes the detection in the field of these minute, mainly singly occurring apothecia somewhat difficult. Development appeared to be mostly on the greyish under-surface of the leaves, where no definite stromatization was observed but some apothecia were found on the consistently black dorsal leaf surfaces, probably depending on which surface was exposed. However, some apparent stromatization of internal leaf tissues was observed in microtome sections and requires further investigation.

Ascospores showed a considerable variation in septation and size. The first find, AH 6864, a single apothecium, contained predominantly simple and guttulate to 1(-2)-septate spores, with some budding "microconidia". However, non-septate spores were mainly found in the later collections but some septate spores were also present, with a few three-celled, and only exceptionally producing apical "microconidia", whilst several were germinating into long hyphae, especially after the water mount had been left overnight. It would therefore appear that the first collection was over-mature. Also, taking into consideration all collections examined, the spores have a wide range of dimensions (12.8-) 13.6-20(24.8) x (4-)5-9(-10) µm, although maintaining a ± constant shape.

Anatomically, this species is a typical **Ciboria** with a firm ectal excipulum of subglobose to angular, brownish cells (**Fig. 2, 5-8**). For this reason and also its large asci and spores, it cannot be placed in the closely related genus ***Moellerodiscus*** Henn. (= ***Ciboriopsis*** Dennis), which, however, may not be distinct from ***Ciboria***.

Ciboria Fuckel is a relatively large genus containing species growing on various substrates but is imperfectly known, with only the amenticolous species monographed. Consulting the database of the third author (J.T.P.), 167 specific epithets combined with ***Ciboria*** have been ascertained in the literature, with 81 referable to other genera, mainly of the Sclerotiniaceae, or synonyms. However, 39 appear to be good species of the genus ***Ciboria***, including some only known from their original collection, whilst 47 species are either little known, of less certain position or possible synonyms. The following is an analysis of the reported occurrence on their substrates or hosts, with some developing on more than one part of the plant:

	Fruits;	Leaves;	Flowers;	Twigs, wood;	Roots
Good	16	11	8	6	1
Uncertain	11	25	3	3	2

Several species with a foliicolous habit have been described during the last decade: ***C. ranikhetiensis*** (*sic*) Ram N. Singh & D. C. Pant, **1984** on ***Berberis*** leaves (India), ***C. gordonii*** A. Funk, **1986** on ***Tsuga heterophylla*** needles (Canada), and ***C. latipes*** A. Holst-Jensen & T. Schumach., **1994** on leaves and stalks of ***Cornus canadensis***, ***Maianthemum canadense*** and ***Rubus saxatalis*** (Canada) and ***Rubus chamaemorus*** (Norway). However, no member of ***Ciboria*** appears to have been previously reported from old leaves of ***Cistus***, which seem to be a rare substrate for these minute saprobious Leotiales as, although covering a vast range in the mediterranean European countries, only a few species have been reported on these shrubs.

Besides its occurrence on ***Cistus*** leaves, the most distinctive features of this species appear to be the small size of the apothecium, particularly the diminutive stipe, and the large spores, often guttulate and later becoming septate, sometimes with polar "microconidia".

Ciboria dumbirensis (Velen.) Spooner, however, on decayed ***Fagus sylvatica*** wood, a much larger species, has somewhat larger, minutely guttulate, rarely 1-2-septate spores and there are several other accepted species in the genus with large and sometimes septate spores. Whilst septate spores producing spherical microconidia appear to be unique in the genus ***Ciboria***, they are common in other sclerotiniaceous genera such as ***Rutstroemia***. Their presence in the present collections may have been due to over-maturity, as they were found in only a few of the apothecia examined.

ACKNOWLEDGEMENTS

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MYCOTAXON

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A NEW COLISPORA (HYPHOMYCETES) FROM TREE HOLLOWS

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Colispora cavincola sp.nov. (Hyphomycetes) is described from an unusual habitat: hollows of living trees. The taxonomy and ecology of this fungus and of two related species - *Colispora elongata* and *Dactylella submersa* - are discussed.

Earlier investigations on various biotopes of aquatic Hyphomycetes in Hungary revealed the common occurrence of a fungus in hollows of living trees (Gönczöl, 1976). Detached or developing conidia of this fungus have often been seen in water samples and on various decaying substrata both collected from tree hollows. The conidia resembled those of *Dactylella submersa* (Ingold) S. Nilsson and *Colispora elongata* Marvanová. Our recent studies on mycoflora of hollows in living trees suggested again that this fungus is a persistent member of fungal communities in these unusual aquatic or semi-aquatic biotopes.

Transfers of conidia of this fungus to laboratory media consistently yielded cultures which we consider to represent a new species of the genus *Colispora* Marvanová.

Colispora cavincola Gönczöl & Révay anam. sp.nov.
Etym.: cavum (L), hollow; incola (L), inhabitant; refers to its habitat.

Coloniae in agaro maltoso modice crescentes, viridogriseae, dein atrogriseae, pars reversa coloniae atrobrunnea, mycelium aerium lanosum, funiculosum, hyphis subhyalinis vel brunneis, 1.5-2 μm crassis, illis in agaro subhyalinis vel pallide brunneis, 2-4 μm crassis, partibus crebris interiectis cellularum inflatarum catenatarum vel agglomeratarum 5-11 μm crass. Conidiophora solitaria, simplicia vel sparse ramosa, usque ad 200 x 3-5 μm. Cellulae conidiogenae apicales, incorporatae, percurrentes vel sympodiales. Conidia acrogena, solitaria, fusoidea vel clavata, recta, raro parum curvata, hyalina, lucida, basi

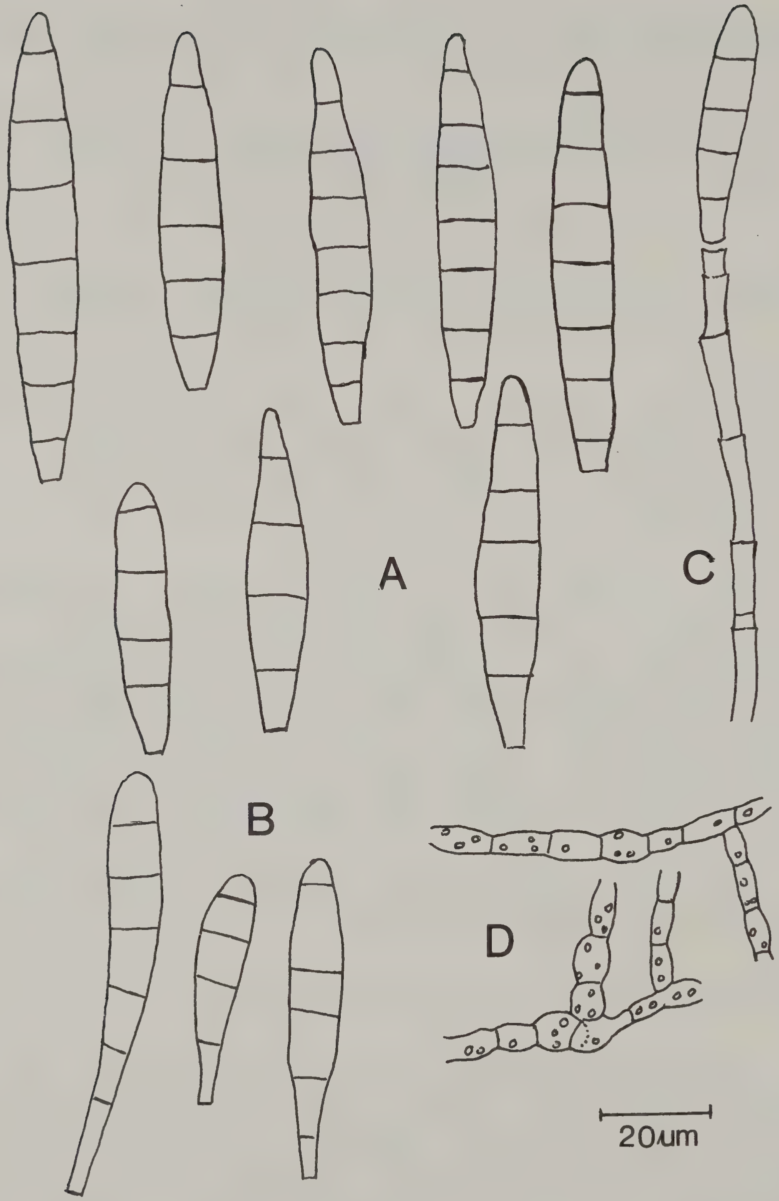

Fig. 1. **Colispora cavincola** BP F-1693; (A) spindle-shaped conidia, (B) pedicellate conidia, (C) just liberated conidium, (D) chains of hyaline inflated cells

truncata, 28-80 (84) x 7-13 (16) μm, 2-7 septata. Dehiscentia conidiorum schizolytica.
Holotypus: e folio putrido *Fagi sylvaticae* e cavo arboris (*Fagus sylvatica*), montes Börzsöny-hegység pr.pag. Királyrét, Hungaria, 23.Sept.1993, J. Gönczöl et Á. Révay (BP F-1693 cultura exs. ex BP 88469).

Colonies on 2% MA growing moderately, reaching 35 mm diam in 35 d at 20 °C, greenish gray later dark gray, reverse dark brown, aerial mycelium woolly, funiculose, hyphae subhyaline to brown, 1.5-2 μm wide, substrate mycelium subhyaline to pale brown, 2-4 μm wide, consisting in great part of groups or chains of inflated cells 5-11 μm diam, containing abundant oil drops. Conidiophores single, simple or sparsely branched, up to 200 x 3-5 μm. Conidiogenous cells apical, integrated, percurrent, sometimes sympodial. Conidia acrogenous, solitary, fusoid to clavate, straight, rarely slightly curved, hyaline, pearly, base truncate, 28-80 (84) x 7-13 (16) μm, 2-7 septate. Conidial secession schizolytic.

Specimens examined: On *Fagus sylvatica* leaves, 5-34 as slide, Bak, Zala County, in wet tree hollow, 12.Nov.1986, J. Gönczöl; On *Fagus sylvatica* leaves, 10-16,17 as slides, Velem, Vas County, in wet tree hollow, 25.Aug.1993; On *Fagus sylvatica* leaves, BP 88469, twigs, BP 88470, cupules and leaves, BP 88471, near Királyrét, Börzsöny-Mts., in wet tree hollow, 23.Sept.1993, 1.Oct.1993, 22.Aug.1994, J. Gönczöl and Á. Révay.

Cultures examined: BP F-1493 ex leaves, Velem, Vas County, 25. Aug.1993; BP F-1693 ex BP 88469; BP F-1794 ex BP 88470.

In vitro sporulation of *Colispora cavincola* depended on incubation conditions. Sporulation was absent on dry agar and late and sparse even after 3-4 weeks underwater incubation, with or without aeration. It became abundant on partially submerged strips of colony. The most profuse sporulation was obtained in a damp chamber after soaking the colony for some days in water. Considerable differences in conidial shape and size were obtained between conidia developed underwater or in air. This was observed mainly on natural substrata. Various proportions of elongated, pedicellate or clavate conidia were obtained in fully submerged conditions (Fig.1.b) as opposed to the predominantly spindle-shaped conidia developed in air (Fig.1.a).

All records of *C. cavincola* from Hungary were obtained from hollows in living beech trees (*Fagus sylvatica*) encountered in submontane beech forests (Melitti-Fagetum silvaticae) up to 800m m.s.m. Summer and autumn samples were all positive for the presence of *C. cavincola* in these habitats. In winter samples however, when frozen plant remains were collected from the same tree hollows and

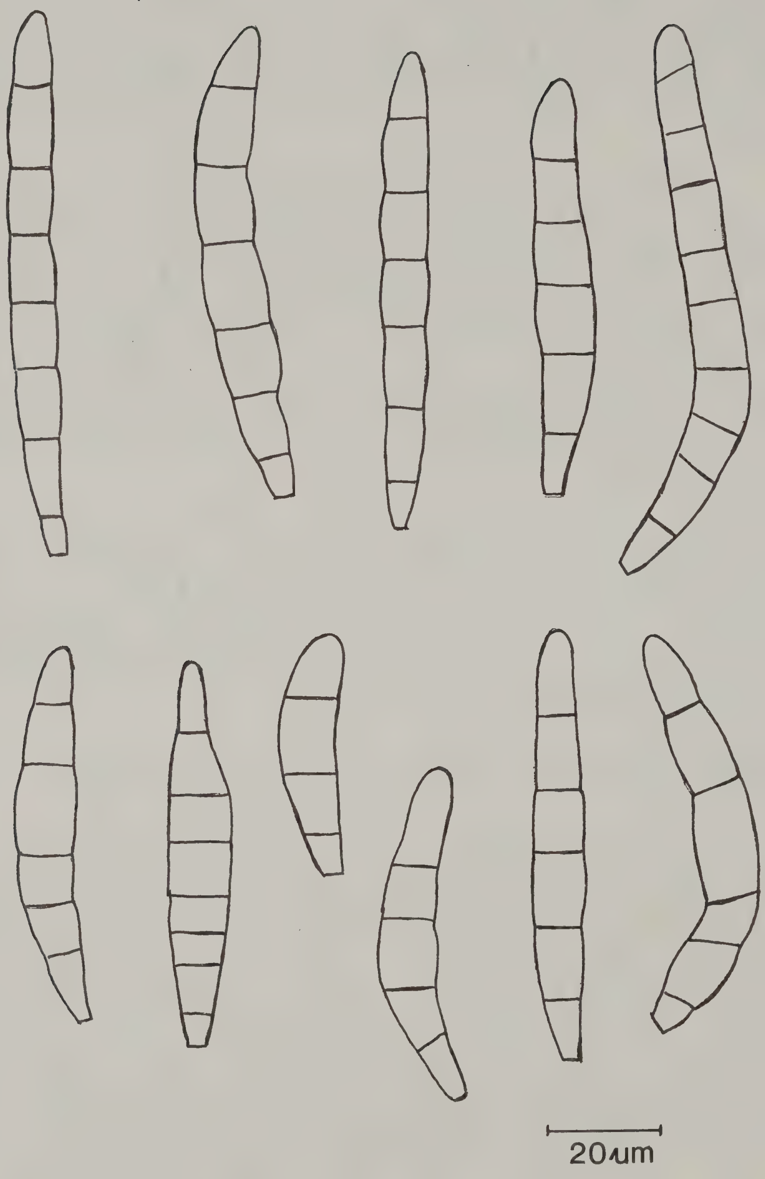

Fig. 2. **Colispora elongata** BP F-1593; conidia

incubated for some time at ca. 10 °C, this species was not recovered. Examination of decaying litter in small forest ponds also failed to produce *C. cavincola*. We have so far failed to find the fungus either in hollows of other tree species (e.g. alder, oak) or in different running waters.

Colispora elongata Marvanová, Trans. Br. mycol. Soc. 90: 614 , 1988

Colonies on 2% MA growing slowly, 40 mm diam./two months/ 20 °C, dark brownish-gray, reverse dark brown; aerial mycelium woolly with a rising conical central part and some concentric rings. Conidial development concurs with that of the original description (Marvanová 1988), and conidial characteristics are given in Table 1.

Specimens examined: From foam in a small stream, 9-79, 80 as slides, in Hidegvíz-völgy valley, near Trizs, Borsod-Abaúj-Zemplén County, 19.March 1991; On *Fagus sylvatica* twig baits, BP 88468, on twigs, 10-18 as slide, in Morgó-patak stream, near Királyrét, Börzsöny-Mts., 17.Nov.1991, 27.Sept.1993, J. Gönczöl and Á. Révay.

Cultures examined: BP F-1291 ex BP 88468; BP F-1593 ex twigs, Morgó-stream, Börzsöny-Mts., 27.Sept.1993.

During the investigation of fungal colonization on twig baits in the Morgó-stream, Börzsöny Mts, *C. elongata* appeared on decorticated twigs after seven months exposure (Fig.2.). It proved to be a persistent colonist during the two-year experiment and occurred as co-dominant with *Tumularia aquatica* (Ingold) Descals & Marvanová, *T. tuberculata* (Gönczöl) Descals & Marvanová and *Anguillospora furtiva* Webster & Descals on heavily decomposed twigs. Its longitudinal distribution was restricted to the upper course of the stream (Gönczöl & Révay, 1993). It was recorded a second time from a small slow running softwater stream, in the Aggtelek National Park, NE Hungary, where it was found in a foam sample and also sporulating abundantly on alder (*Alnus glutinosa*) and hornbeam (*Carpinus betulus*) leaves (Gönczöl & Révay, 1992).

The genus *Colispora* was erected by Marvanová (1988) with a single species, *C. elongata*, conidia of which had been obtained from foam in streams in West Slovakia. *C. elongata* was characterised with simple or sparsely branched, hyaline conidiophores, and percurrent or sympodial conidiogenous cells. The conidia are hyaline, septate, fusiform or clavate, straight or slightly curved. A second species, *C. curvata* Nawawi & Kuthubutheen, was later described from a fresh-water stream in Malaysia (Nawawi & Kuthubutheen, 1989).

Dactylella submersa (Ingold) S. Nilsson, Bot. Notiser 115: 78, 1962
Pyricularia submersa Ingold, Trans. Br. mycol. Soc. 27: 45, 1944

Dactylella submersa is unquestionably closely related to both *C. elongata* and *C. cavincola*. In spite of its early discovery we know little about this species. Amongst the voluminous literature accumulated on aquatic Hyphomycetes since 1944, few authentic records of this fungus have been made. Ingold (1944) mentioned three occurrences on submerged decaying leaves of oak in England or Northern Ireland. Later, it was referred as a rare species in Britain (Ingold, 1975).

Casper (1965) reported *D. submersa* from Germany on alder, beech and birch leaves submerged in lakes. Marvanová & Marvan (1969) reported data concerning this species from slowly running or nearly stagnant waters in Cuba. Dudka (1974) published some records from Ukraine. Iqbal (1980) recorded *D. submersa* in Pakistan as common on fallen deciduous leaves, pine needles and branches, but did not mention the water types, where the samples were found.

Nilsson (1962) made a new combination suggesting that it seemed reasonable to keep the known aquatic species of *Pyricularia* Sacc. and *Dactylella* Grove in the genus *Dactylella*. In his comprehensive work, Nilsson (1964) recorded the occurrence and distribution of this fungus in Sweden. He found that "small waters as pools or ditches or calm sites of larger ones" are its favourite habitats.

The taxonomic position of *D. submersa* has remained uncertain since its description. Ingold expressed his doubts in the original publication about the placement of his species in *Pyricularia* and he later pointed out that it seemed also unlikely that *Dactylella* would be a satisfactory genus (Ingold 1944, 1975). Marvanová discussed the similar morphological and cultural characteritics of *Colispora elongata* and *D. submersa* and concluded that the two species are evidently congeneric and perhaps synonymous. In the absence of an authentic living culture she did not make a new combination.

A fungus found in tree hollows in SW Hungary was also identified as *D. submersa* (Gönczöl, 1976). Although this fungus was authenticated by C.T. Ingold (1977, pers. comm.) it is now questionable whether it actually *was D. submersa* or *C. cavincola*. Unfortunately no cultures of that fungus had been made at the time but the frequency of *C. cavincola* in tree hollows recently suggest that it was the latter. Although *C. cavincola* has longer and wider conidia than in the protologue for *Pyricularia submersa* there is an overlap in conidial dimensions. Therefore the possibility of misidentification is great.

It is of interest to point out that the similarity both in cultural characters and conidial morphology of *C. cavincola* and *C. elongata* is even greater. Nevertheless we prefer to describe *C. cavincola* as a new species for the following reasons:

1. minor differences in conidial dimensions (Table 1.),

2. all strains of *C. elongata* seen by us produce curved conidia in considerable numbers while only slightly curved conidia occur in minimal proportions in *C. cavincola*,

3. a greenish colour is characteristic in young cultures of *C. cavincola* but absent in those of *C. elongata*,

4. a distinct difference in the favourite habitat of the two species.

We believe that *C. cavincola* has an intermediate position between *C. elongata* and *D. submersa*. Nevertheless this species concept may be not acceptable in the future when more detailed knowledge on the taxonomy and ecology of *Colispora* species is available.

Table.1. Conidial diagnostic characters of *Colispora elongata*, *C. cavincola* and *Dactylella submersa*

	C. elongata	**C. cavincola**	**D. submersa***
size	25-105 x 6-11(13)	28-84 x 7-13(16)	35-65 x 6-9
shape	fusoid or clavate straight or curved	fusoid or clavate straight or rarely slightly curved	fusoid straight
lenght /width ratio	6-11, commonly around 10	4-7, never over 10	6-7
septa	3-9	2-7	3-6

* Data from Ingold's description (1944)

Acknowledgements

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MYCOTAXON

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STRIGULA KAITOKENSIS SP. NOV. FROM NEW ZEALAND

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Abstract - The foliicolous lichen **Strigula kaitokensis** Sérusiaux & Polly is described as new from New Zealand. It is characterized by its large and expanding involucrellum that causes secondary aggregation of individual perithecia. Mucoid appendages are present at both ends of ascospores.

A new foliicolous species of **Strigula** has been found in collections from New Zealand and is described in this paper.

Strigula kaitokensis Sérusiaux & Polly sp. nov.

Strigula species insignis expanso involucrello (et itaque aggregatis peritheciis) sporibusque appendicibus mucosis terminalibus praeditis.

Thallus subcuticular, usually half-circular as it grows on the margins of the leaves or scars, 0.5-1 cm in diam., exceptionally up to 2 cm in diam., with small, rounded lobes at the margins, bright green to greyish green, without bluish tinge, smooth and nitidous, without prothallus, 10-15 (-20) μm thick. Photobiont: a species of **Cephaleuros** (Trentepohliaceae), with rectangular or more or less rounded cells, 8-15 x 4-6 μm, yellowish green, arranged in radiating rows and forming a horizontal plate within the thallus.

Perithecia abundant, black, hemispherical to subconical, single or appearing to be fused because of a conspicuous, black, spreading involucrellum, that can gather up to 5-6 perithecia, but locules never fused and keeping their own apical ostiole; single perithecia 0.4-0.5 mm in diam., groups of aggregated perithecia up to 1.3 mm in diam.; involucrellum spreading between the upper surface of the host cells and the thallus, forming an irregularly delimited, subhorizontal, c. 0.3-0.4 mm wide plate around the perithecia and becoming rather thick (up to 150 μm) when developing between closely located ones; outer wall and involucrellum black in sections, heavily carbonized, outer wall usually absent under the center of the perithecial chamber; inner wall pale brown, less than c. 10 μm thick; perithecial chamber somewhat flattened, c. 240-250 x 140-160 μm; paraphyses abundant, simple or rarely with a few branches, with several transverse septa, not inflated at apices; asci cylindrical, 85-90 x 8-9 μm, thin-layered except for the apex which is distinctly thickened and which contains a small ocular chamber; spores 8 per ascus, uniseriate, fusiform, with rounded ends, 1-septate, the distal cell slightly larger than the proximal one, slightly constricted at the septa, not breaking into pieces, with small, cap-like or infundibuliform, mucoid appendages at both ends, with several oil guttules in each cell in immature ones and with only one large guttule in mature ones, (12-)13-15 x 4.5-5.5 μm.

Pycnidia producing macroconidia like a flat cone, black and nitidous, 0.15-0.2 mm in diam.; conidiogenous cells lining the bottom of the pycnidial cavity, ampulliform, with a short, attenuated neck, c.5 x 2 μm; macroconidia numerous, subapically produced, narrowly ellipsoid to mostly bacilliform, or sometimes almost biclavate, slightly but distinctly narrower at the septa, with rather conical ends, 1-septate, with 1-2 oil guttules in each cell, 9.5-10.5 (-11) x 3-3.5 μm. Pycnidia producing microconidia punctiform, c. 40 μm in diam., black; conidiogenous cells not seen; microconidia bacilliform to slightly ellipsoid, 2-3 x 1 μm.

Type: New Zealand, North Island, Kaitoke Waterworks Reserve, N of Wellington, on **Beilschmiedia tawa** leaves in **Melicytus ramiflorus/Dacrycarpus dacrydioides** forest, coll. B. Polly, 25 iii 1995 (WELT n° 4753-holotypus; CHR-, LG-isotypi; isotypi to be distributed in R. Lücking Lichenes Foliicoli Exsiccati).
Other specimen: New Zealand, North Island, Church Road Scenic Reserve, near Kaitaia, Mangonui Co., on leaves in old bush remnant, coll. J. K. Bartlett 18616 p.p., 8 iv 1982 (LG).

Characters of the asci, ascospores and macroconidia of this taxon immediately point to the genus **Strigula** Fr., one of the most commonly collected genera amongst the foliicolous lichens (Santesson 1952: 138-194). Harris (1975: 131-148) has convincingly demonstrated that several epiphytic or saxicolous species, previously referred to other genera (**Arthopyrenia** Massal., **Porina** Müll. Arg., etc.), also belong to that genus. This new species is easily distinguished from all other species described in the genus **Strigula** or referred to it by its large and expanding involucrellum that can join several perithecia.

A large, expanding involucrellum is known in several species of the closely related genus **Phylloporis** Clem.: **P. platypoda** (Müll.Arg.) Vezda, **P. multipuncta** (R. Sant.) Vezda and **P. viridis** Lücking (see Santesson 1952: 214-217 & Lücking 1991: 276-278 for descriptions of these species). These species are easily distinguished by their photobiont (**Phycopeltis**) and by their conical, acute perithecia that are very rarely aggregated.

The perithecia are always single in their early stages but they eventually become aggregated due to two phenomena:

(i) they are often close to each other so that, as their involucrellum expands a great deal around them, they become secondarily aggregated in a "common" involucrellum shelf; these aggregates cannot be regarded as stroma or pseudostroma as the tissues involved in their formation are all of perithecial origin;

(ii) around mature perithecia, secondary perithecial primordia develop under the lasting "shelf" formed by the involucrellum; in such situations, the perithecial chambers do not appear to fuse laterally and each of them develops its own apical ostiole.

To our knowledge, ascospores appendages were never reported in the genus. Roux & Sérusiaux (1995) have however observed mucoid appendages at both ends of ascopores in a specimen of **Raciborskiella janeirensis** (Müll. Arg.) R. Sant. (**Raciborskiella** Höhnel is closely related to **Strigula**; Harris 1975: 131 has even reduced it into synonymy with **Strigula**). We cannot guarantee that those appendages are a good taxonomic character for **S. kaitokensis** as ascopores are usually observed in KOH solution, which destroys those mucoid structures. There is however no doubt that they do not occur in many species of the genus. When adequately preserved during the microscopic manipulation, the appendages of **S. kaitokensis** are present at both ends of the ascopores, they are cap- or funnel-shaped and they can be turned inside out like an umbrella.

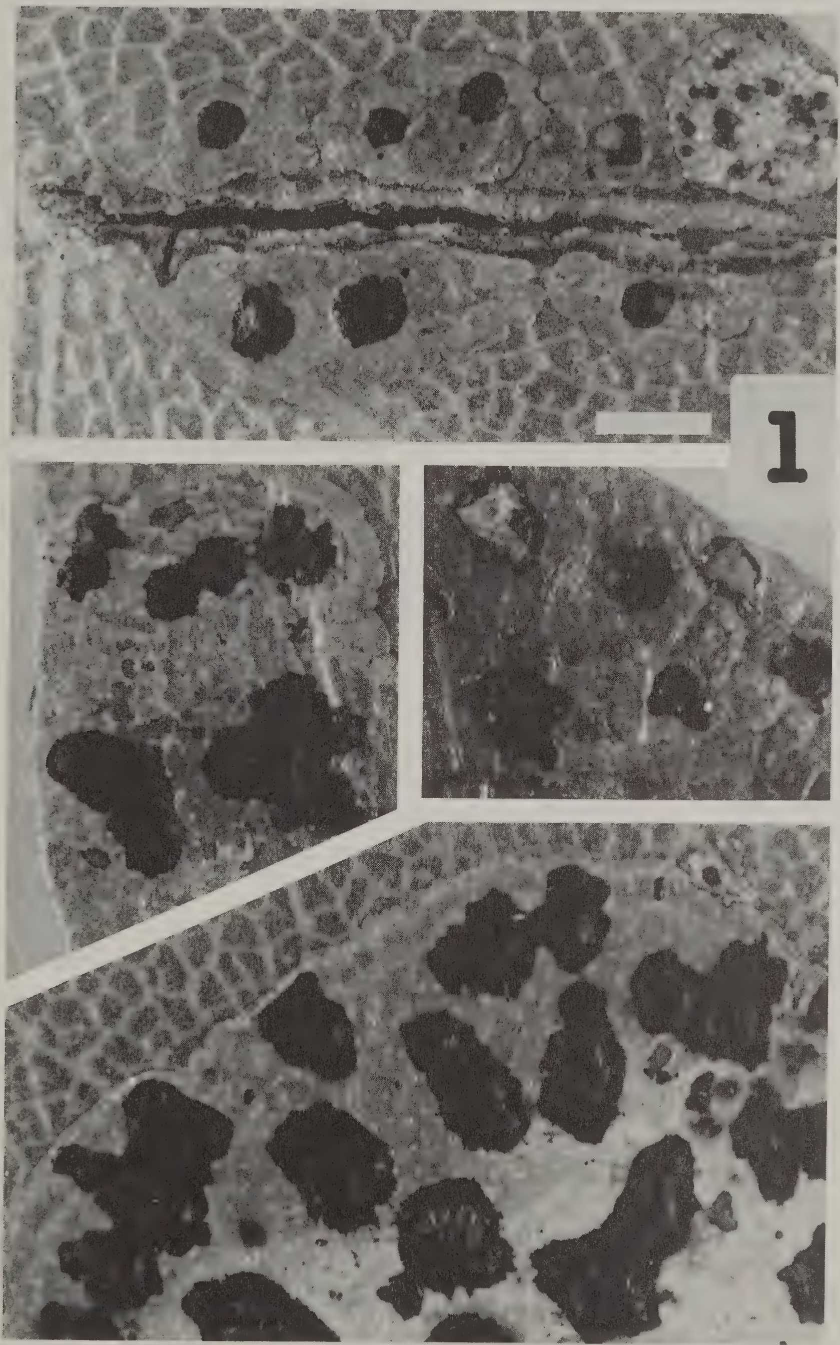
In all species of **Strigula**, the macroconidia are provided with mucoid appendages at both ends. Most foliicolous species produce very long ones as does **S. kaitokensis** (see Roux & Bricaud 1993: 124 for drawings of the foliicolous **S. nitidula** Mont. and **S. smaragdula** Fr.). These appendages were first described by Nag Raj (1981) who also thoroughly describes the conidia ontogeny.

So far, **Strigula kaitokensis** is known from only two localities on the North Island in New Zealand. Although still little-studied, the genus is well represented in the foliicolous flora of that country: Galloway (1985: 563-565) reports the presence of the widespread **S. smaragdula** Fr. (= **S. elegans** (Fée) Müll. Arg.), **S. nitidula** Mont. and **S. subelegans** Vainio. At least two further, undescribed species occur in the collections left with one of us (E.S.) by the late J. K. Bartlett; they will be described in another paper.

Acknowledgements.-

We wish to thank very warmly Prof. J. Lambinon and Drs. R. Lücking and C. Roux for their help in reviewing this manuscript and for valuable comments.

Strigula kaitokensis Sérusiaux & Polly (type-collection) 1. General habit. Scale = 0.1 mm.



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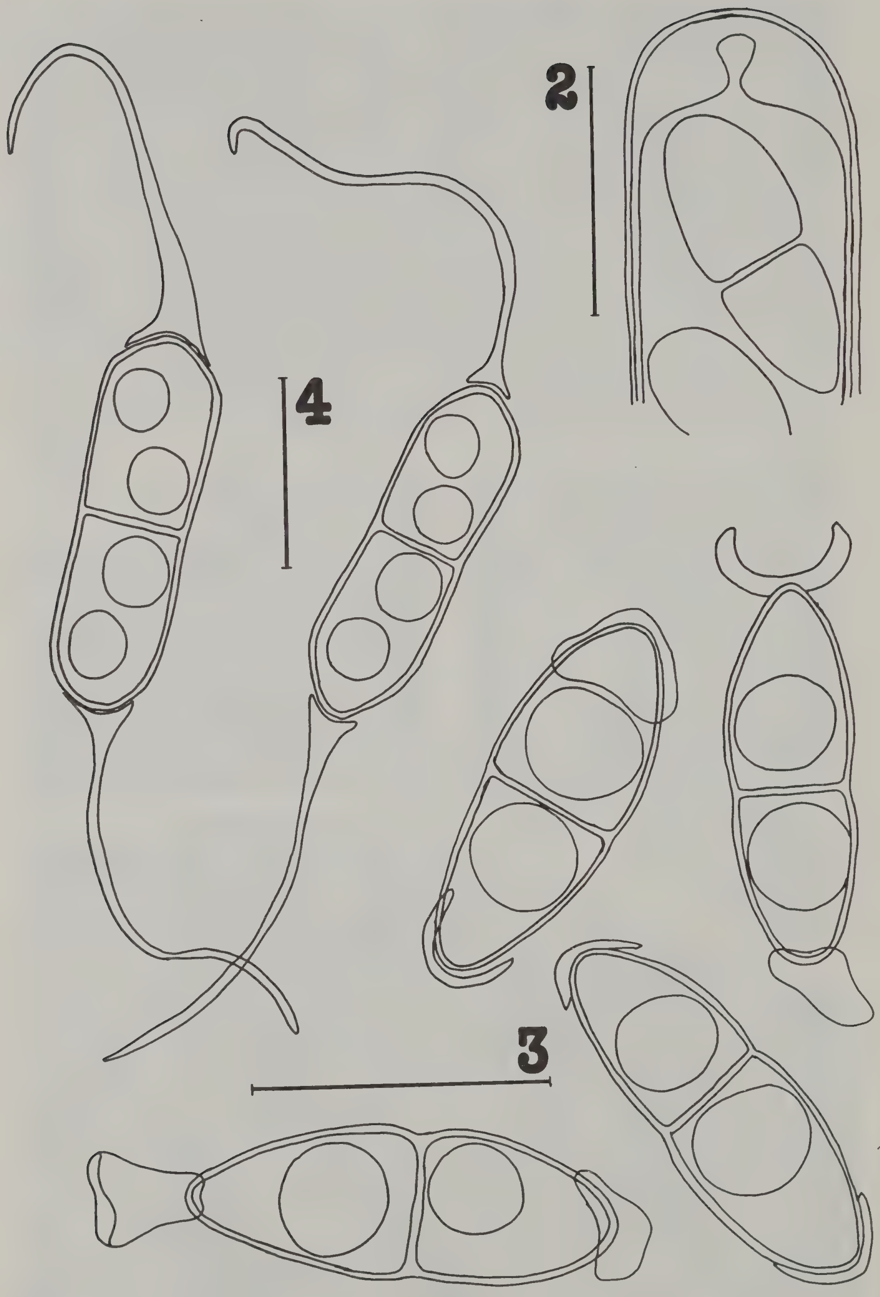

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Strigula kaitokensis Sérusiaux & Polly (type-collection) 2. Ascus apex. Scale = 10 μm. 3. Ascospores. Scale = 10 μm. 4. Macroconidia. Scale = 5 μm.

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Diorchidium taiwanensis sp. nov. (Uredinales), a new *Diorchidium* from Taiwan[*]

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Recently a *Diorchidium* sp. was collected in Taiwan on *Derris* cf. *laxiflora* Benth. (Fabaceae). *Derris* spp. are hosts of several rust fungi, especially species of the genus *Hapalophragmium* (Lohsomboon et al., 1992; Thirumalachar, 1950), but only a single species of *Diorchidium*, *D. koordersi* Wurth (Wurth 1907, 1908), has been recorded on members of the genus *Derris*. No *Diorchidium* has been reported from Taiwan so far (Hiratsuka & Chen 1991). The taiwanese rust was different from *D. koordersi* and other *Diorchidium* spp. Hence a new species, *Diorchidium taiwanensis* (Figs. 1, 3-4), is proposed.

Diorchidium taiwanensis R. Berndt, sp. nov.
Pycniis et **urediniis primariis** amphigenis, in maculis brunneis hypertrophiis foliis. **Pycniis** subcuticularibus, typo 7, urediniis primariis circumdatis. **Urediniis primariis** dense aggregatis, subepidermalibus, parvis, cinnamomeis, paraphysibus nullis. **Urediniosporis primariis** pedicellatis, ovoideis vel pyriformibus, (26-) 28-32 x 19-23 μm, echinulatis, membrana 1-1.5 μm, ad apicem usque 5 μm crassa, duobus poris germinationis instructis, poris ± aequatorialibus. **Urediniis secundariis** circum uredinios primarios dispersis, subepidermalibus, minutis, brunneis, paraphysibus nullis. **Urediniosporis secundariis** ellipsoideis, (24-) 25-27 x (17-) 19-22 μm, echinulatis, membrana uniformiter ± 1.5 μm crassa, duobus poris germinationis instructis, poris oppositis, ± aequatorialibus, locis ± levibus circumdatis. **Teliis** non visis. **Teliosporis** in urediniis secundariis, 2-cellularibus, septis verticalis, 34-38 μm latis x 29-34 μm altis, membrana ± 1 μm crassa, ad apicem paulum (usque 2 μm) incrassata, verrucis tenuis, cylindricis, usque 5 μm largis exornatis, verrucis maxime subapicalibus et apicalibus. Cellulis cum solo poro germinationis, poris germinationis indistinctis, maximam partem subapicalibus.
In foliis *Derridis* cf. *laxiflorae* Benth. (Fabaceae).

Pycnia and **primary uredinia** amphigenous on round, brown, hypertrophied spots of the host leaves. **Pycnia** subcuticular, type 7, surrounded by the primary uredinia. **Primary uredinia** aggregated, small, cinnamon brown, subepidermal, without paraphyses.

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[*] Part 119 of the series "Studies in Heterobasidiomycetes."

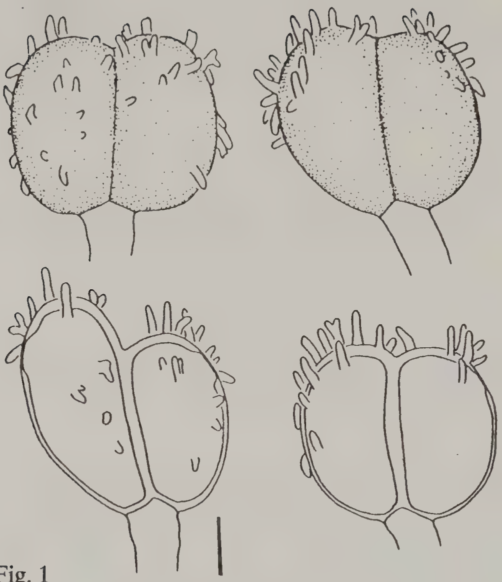

Fig. 1

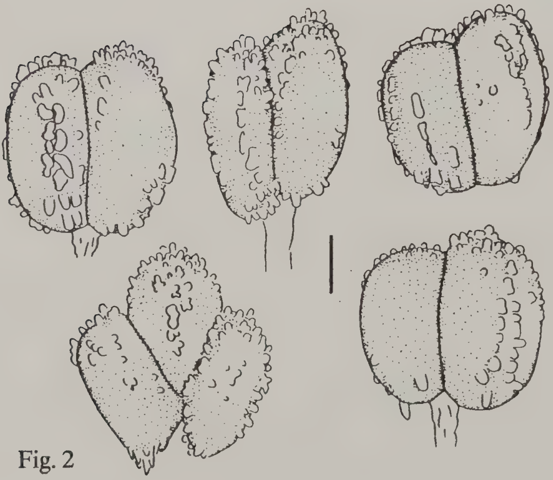

Fig. 2

Fig. 1: *Diorchidium taiwanensis*, teliospores. Scale bar = 10 μm (in all figures). Fig. 2: *D. koordersi*, teliospores. A three-celled teliospore is illustrated. No pedicel could be found attached to that spore.

Primary urediniospores pedicellate, ovoid or slightly pyriform (26-) 28-32 x 19- 23 μm, wall 1-1,5 μm thick, apically thickened up to 5 μm, moderately echinulate, germ pores two, ± equatorial. **Secondary uredinia** scattered around the primary uredinia, subepidermal, very small, light brown, without paraphyses. **Secondary urediniospores** ellipsoid, (24-) 25-27 x (17-) 19-22 μm, wall uniformly about 1.5 μm thick, moderately echinulate, germ pores two, ± opposite and equatorial, surrounded by almost smooth wall areas. **Telia** not seen. **Teliospores** within the secondary uredinia, two-celled with vertical septa, 34-38 μm broad x 29-34 μm high, wall thin, about 1 μm, apically slightly thickened up to 2 μm, teliospores with cylindric, slender warts up to 5 μm long, warts especially apically and subapically, germpores indistinct, one per cell, mostly subapical.
On the leaves of *Derris* cf. *laxiflora* Benth. (Fabaceae).
Holotype in Berlin (Berlin, Germany).

Specimens examined:
Diorchidium taiwanensis R. Berndt
- Taiwan R.O.C., Prov. Pintung, Kenting Natl. Park, near Oluangpi, on *Derris* cf. *laxiflora* Benth. [0, II, II, III], 30. VI. 1990, leg. R. Berndt, **Holotype**!
- Taiwan R.O.C., Prov. Taichung, Da Ken recreation area, Kwan-Yin mountains, on *Derris* sp. [0, II], 15. VI. 1990, leg. R. Berndt.
Diorchidium koordersi Th. Wurth
Indonesia, Java, at Penoenggalan, Oberförsterei Bagelen, on *Derris elliptica* Benth., leg. S. H. Koorders, Holotype.

D. taiwanensis appears to be related to *D. koordersi* by ± apical germ pores of the teliospores and by selection of the same host genus. The species can be separated easily, however, by several characters:

	D. taiwanensis	***D. koordersi***
teliospore ornament	long, slender warts, crowded apically on spore cells.	bold, irregular warts, ± in rows and crowded apically.
secondary urediniospores	two germpores.	mostly four germ pores.
location of sori	0, I causing hypertrophied spots on leaf blade. II, III around the hypertrophied area.	II, III mostly on petioles and midribs, causing hypertrophy and distortions.

The genus *Diorchidium* is characterized by two-celled teliospores with vertical septa and type 7 pycnia (Arthur 1924; Cummins & Hiratsuka, 1983). As is known, the genus has been a provisional home for rusts with such "diorchidioid" teliospores, especially rusts which later proved to be *Puccinia* spp. Some observations indicate, that also *D. koordersi* and possibly *D. taiwanensis* are not typical *Diorchidium* spp. Because of the apical germ pores of the teliospores, Boedijn (1959) proposed a new genus, *Diphragmium*, to accomodate *Diorchidium koordersi*. He mentioned that *D. koordersi* appeared to be "nearly related" to the genus *Hapalophragmium*. In most *Diorchidium* spp. the germ pores of teliospores seem to be located apically. Cummins & Hiratsuka (1983) did not consider the location of the germ pores to be important enough to justify a new genus, and kept *Diorchidium koordersi*. Wurth (1907) observed the occurrence of single three-celled teliospores in *D. koordersi*. In contrast to Boedijn (1959) he stated, that the arrangement of the spore cells was different from *Hapalophragmium* teliospores, as the spore cells were united laterally "coming close to *Anthomyces brasiliensis* Dietel ...." Examination of the type material of *D. koordersi* again revealed single three-celled teliospores (Fig. 2). These spores closely resemble teliospores of *Hapalophragmium pulchrum* (Racib.) H. Sydow in their ornament and spore cell arrangement. Three-celled teliospores could not be found in *D. taiwanensis*. The teliospore ornament is quite similar, however, to that of *Hapalophragmium philippinense* Lohsomboon & Sato and to *H. nepalense* Durrieu. The apical cells of the teliospores of *H. philippinense* are easily detached (Lohsomboon, pers. comm.) and the remaining spores may thus be especially similar to *D. taiwanensis* teliospores. The uredinia are paraphysate, however, in *H. philippinense*. The clear preference of *Hapalophragmium* spp. for *Derris* hosts may be regarded as further argument to consider *Diorchidium koordersi* and *D. taiwanensis* to be more closely related to *Hapalophragmium* than to *Diorchidium*.

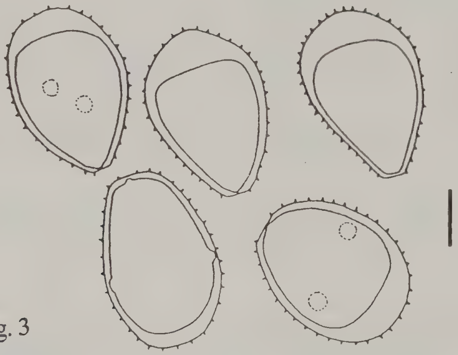

Fig. 3

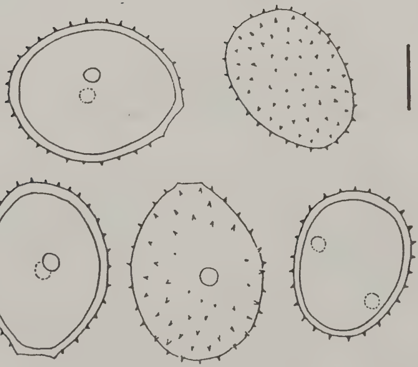

Fig. 4

Fig. 3: *Diorchidium taiwanensis*, primary urediniospores. Fig. 4: *D. taiwanensis*, secondary urediniospores. Scale bars = 10 μm.

The genus *Hapalophragmium* is based on its three-celled teliospores with two cells basal and one above. A broader genus concept of *Hapalophragmium* may be necessary, however, to accomodate rusts like *D. koordersi* and *D. taiwanensis* which have two-celled teliospores, but which otherwise appear to be related to three-celled *Hapalophragmium* spp. Further, a thorough revision of *Diorchidium* is highly desirable. At the present it seemed best to retain both *D. koordersi* and *D. taiwanensis* in the genus *Diorchidium*.

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New species and a new variety of rust fungi (Uredinales) on legumes from tropical America*

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Ravenelia palenquensis, *Ravenelia magnispina*, *Uredo santa-rosensis*, *Uredo pasochoae* and *Uraecium guanacastensis* are described as new species. A new variety, *Ravenelia verrucata* var. *apurensis*, is proposed. All species parasitize leguminous hosts in tropical America. The *Uredo* species and *Uraecium guanacastensis* probably belong to the genus *Ravenelia*.

Ravenelia palenquensis R. Berndt, sp. n. (Fig. 1)
Spermogonia, aecia et uredinia non visa.
Soris teleutosporiferis minutis, brunneis, plus minusve epiphyllis, evolventis in cellulis mesophylli et ergo subepidermalibus, paraphysibus nullis.
Capitulis teleutosporarum brunneis, irregulariter rotundatis, 40-50 μm diametr., fere quinque-cellularibus, sporis centralis quattuor sporis periphericis circumdatis, sporis omnibus spinis frequentis adornatis, spinis irregulariter distributis, 3-4 (-5) μm longis. Cystidiis fere tres, semipendulis, hyalinis, hygroscopicis. Pedicellis capituli teleutosporarum brevissimis, duobus (?) hyphis compositis.
In foliis pinnatis *Pithecellobii macradenii* Pitt. (Mimosaceae).

Spermogonia, aecia and uredinia not seen.
Telia minute, brown, mostly epiphyllous, developing within mesophyll cells and thus appearing subepidermal, without paraphyses.
Teliospore heads brown, irregularly rounded, even subangulate, 40-50 μm in diameter, mostly five-celled, the central spores surrounded by four peripheral spores, each spore with numerous, irregularly distributed spines, spines 3-4 (-5) μm long. Teliospore heads with mostly three semipendulous, hyaline, hygroscopic cysts, pedicels very short, composed of two (?) hyphae.
On the leaves of *Pithecellobium macradenium* Pitt. (Mimosaceae).
Holotype in AAU (Aarhus, Denmark). Isotypes in PUR (Arthur Herbarium, West Lafayette, USA) and the author's herbarium (HeRB A-313).
Ecuador, Prov. Pichincha, Santo Domingo de los Colorados, at the Río Palenque Science Station, 12. Dec. 1972, leg. C. H. Dodson, ex herbario AAU.
This species differs from other Ravenelias on *Pithecellobium* by the small, five-celled teliospore heads which develop subepidermally. It also differs from other Ravenelias with simple spore heads from different host genera. The telia of *R. palenquensis* do not develop beneath the epidermis originally, but formation starts within the cells of the host parenchyma (especially the palisade parenchyma), which are destroyed consequently.

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[*] Part 121 of the series "Studies in Heterobasidiomycetes"

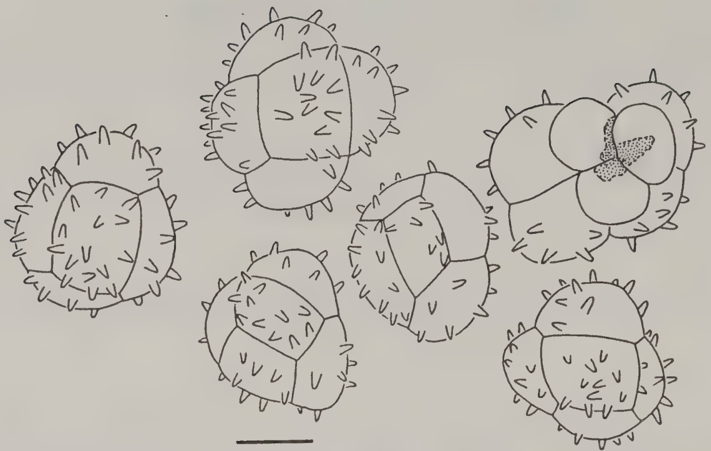


Fig. 1: Teliospore heads of *Ravenelia palenquensis*. Upper right spore head from below with cyst cells. Scale bar = 20 μm.

Ravenelia magnispina R. Berndt, sp. n. (Fig. 2)
Urediniis amphigenis, minutis, cinnamomeis, subcuticularibus, paraphysibus nullis. **Urediniosporis** lucide brunneis, late ellipsoideis, echinulatis, 16-19 x 13-15 μm (circiter 17.5 x 14 μm), membrana 1.5-2 μm, ad apicem usque 3 μm incrassata, poris germinationis 7-8 sparsis instructis.
Soris teleutosporiferis amphigenis, atro-brunneis, subcuticularibus, paraphysibus nullis. **Capitulis teleutosporarum** atro-brunneis, ± orbicularibus, hemisphaericis, 70-85 μm diam., ex 6-8 cellulis in omni directione compositis, sporis omnibus aculeus singulus ± hyalinus 8-12 μm longus basi 4.5-5.5 μm crassus obsitis. Cystidiis globosis, semipendulis, eodem numero quo sporis singulis. Pedicello hyalino, brevi, ex hyphis paucis composito.
In foliis *Cassiae robinifoliae* Benth. (Caesalpiniaceae).
Uredinia amphigenous, minute, cinnamon-brown, subcuticular, without paraphyses. **Urediniospores** light brown, broadly ellipsoid, echinulate, 16-19 x 13-15 μm (on mean 17.5 x 14 μm), spore wall 1.5-2 μm, towards the spore apex slightly thickened up to 3 μm, with 7-8 scattered germ pores.
Telia amphigenous, blackish-brown, subcuticular, without paraphyses. **Teliospore heads** blackish-brown, ± round, hemispherical, 70-85 μm diam., 6-8 spores on the sporehead diameter, each spore with a single stout, ± hyaline spine 8-12 μm long, 4.5-5.5 μm broad at the base. Cystidia globose, semi-attached, of the same number as spores. Pedicell hyaline, short, formed by few hyphae.
On leaves of *Cassia robinifolia* Benth. (Caesalpiniaceae).
Ecuador, Prov. Guayas, Isla Puná, path from Agua Piedra to Bellavista, almost on sea level, 5. Oct. 1987, leg. J. E. Madsen, ex herbario AAU.
Holotype in AAU (Aarhus, Denmark), isotype in the author's herbarium (HeRB A-316) and PUR.

Cassia spp. are hosts of about 23 *Ravenelia* spp. *Ravenelia magnispina* is most similar to *R. spinulosa* Dietel & Holway. *R. spinulosa* appears to be quite a variable species with regard to teliospore ornament and urediniospore size. *R. spinulosa* var. *spinulosa* and var. *papillifera* (Sydow) Cumm. & Baxter are distinguished by the teliospores having pointed spines or shorter papilla (Cummins & Baxter, 1976). Var. *microspora* Cumm. & Baxter has smaller urediniospores than *R. spinulosa* var. *spinulosa*. *R. magnispina* differs from *R. spinulosa* var. *spinulosa* in the stout, considerably longer aculei of the teliospores, smaller urediniospores with a spore apex which tends to be slightly thickened, and lacking paraphyses. Urediniospores seem to be similar to those of var. *microspora*, but no apical thickening has been reported for the latter. Further, uredinia of var. *microspora* are paraphysate.

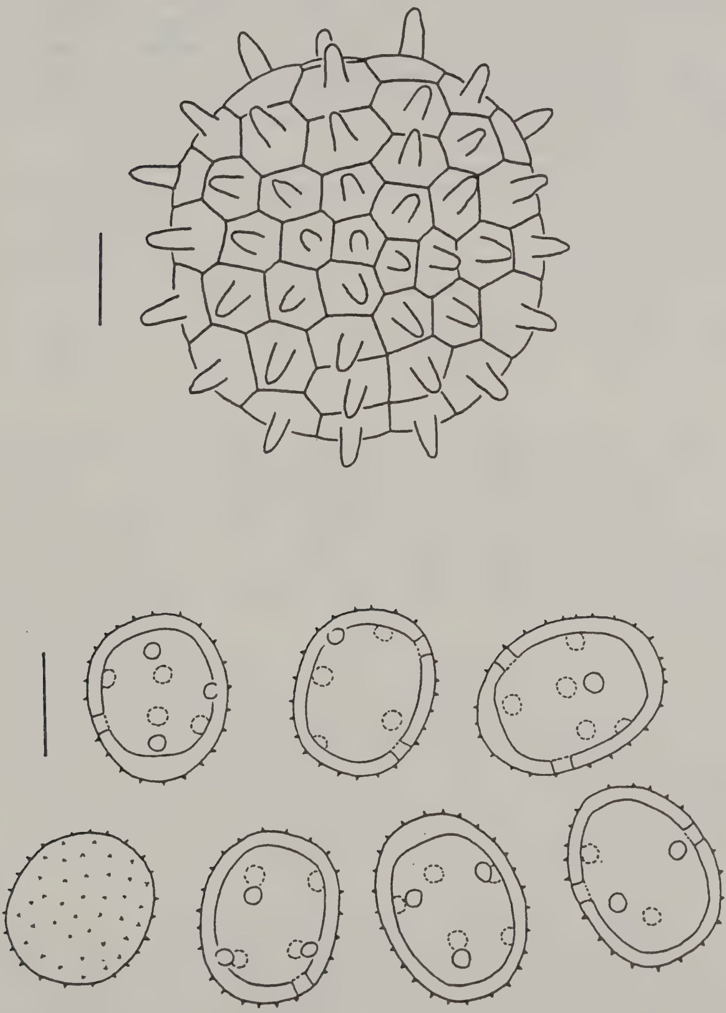


Fig. 2: *Ravenelia magnispina*. Teliospore head (scale bar = 20 μm) and urediniospores. Scale bar = 10 μm.

Uredo santa-rosensis R. Berndt, sp. n. (Figs. 3, 7)

Urediniis amphigenis, maxime epiphyllis, sparsis, subepidermalibus, profundis, mox nudis, epidermide rupta et lamine materiae fungi cinctis, brunneis, paraphysibus nullis. **Urediniosporis** oblongo-ellipsoideis, remote echinulatis, plus minusve flavidis, 45-54 x 17-20 μm (circiter 49 x 19 μm), episporio 2 μm crasso, membrana ad apicem 5-8 (-9) μm crassa, basim versus usque 3-4 μm crassa, poris germinationis (4-) 5 (-6), equatorialibus, papillis tenuibus instructis.

In foliis *Pithecellobii* cf. *dulcis* (Roxb.) Benth. (Mimosaceae).

Uredinia amphigenous, mostly epiphyllous, scattered, subepidermal, deep-seated in the palisade parenchyma, covered by the torn host epidermis and a layer of fungal cell wall material, early naked, brown, without paraphyses. **Urediniospores** oblong-ellipsoid, sparsely echinulate, ± ochraceous, spores 45-54 x 17-20 μm (on mean 49 x 19 μm), spore wall about 2 μm thick, apically thickened up to 5-8 (-9) μm, basally about 3-4 μm thick, germ pores (4-) 5 (-6), equatorial, covered by flat, inconspicuous papillae.

On leaves of *Pithecellobium* cf. *dulce* (Roxb.) Benth. (Mimosaceae).

Costa Rica, Prov. Guanacaste, Santa Rosa Natl. Parc, 24. Mar. 1991, leg. R. Berndt.

Holotype (HeRB 2630) in the author's herbarium. Isotypes in CR (San José, Costa Rica) and PUR.

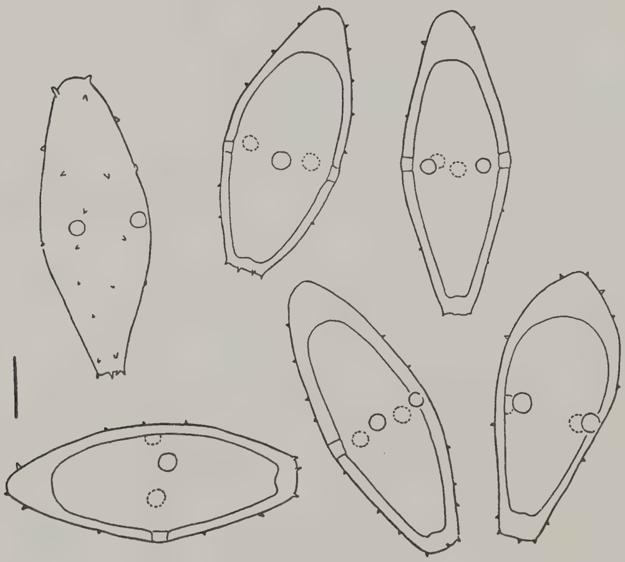


Fig. 3: *Uredo santa-rosensis*. Urediniospores. Scale bar = 10 μm.

The species will most probably prove to belong to a species of *Ravenelia*. It differs from other rusts on *Pithecellobium* by the very large urediniospores with a strongly thickened apex. *Uredo amazonica* (Sydow) Baxter is somewhat similar, but has much smaller urediniospores. The formation of a layer of fungal cell wall material covering the uredinia (Fig. 7) has not been described for *Ravenelia* spp. and other rusts on *Pithecellobium*. Cunningham (1889), however, illustrated a similar fungal layer for telia of *Ravenelia sessilis* Berkeley, and in the raveneliaceous *Diabolidium calliandrae* R. Berndt a rigid and persistent fungal peridium was observed covering the telia of the fungus (Berndt, 1995). There is not much known about that feature, but it may be regarded as an adaption to the dry and hot climates where many raveneliaceous rusts occur.

Uredo pasochoae R. Berndt, sp. n. (Fig. 4)
Urediniis amphigenis, parvis, sparsis, subcuticularibus, cinnamomeis, mox nudis et pulverulentis, paraphysibus nullis. **Urediniosporis** ellipsoideis, flavidis usque subbrunneis, dense echinulatis, 28-33 x 17-20 μm (circiter 30 x 19 μm), episporio uniformiter 2-2,5 (-3) μm crasso, poris germinationis (10-) 11-13, dispersis.
In foliis *Cassiae tomentosae* L. (Caesalpiniaceae).
Uredinia amphigenous, small, scattered, subcuticular, cinnamon brown, early naked and pulverulent, without paraphyses. **Urediniospores** ellipsoid, yellowish to light cinnamon brown, densely echinulate, 28-33 x 17-20 μm (on mean 30 x 19 μm), spore wall uniformely 2-2,5 (-3) μm thick, germ pores (10-) 11-13, scattered, rarely approximately bizonate.
On leaves of *Cassia tomentosa* L. (Caesalpiniaceae).
Ecuador, Prov. Cotopaxi, Pasochoa Forest Reserve, at the visitors center, 22. Mar. 1993, leg. R. Berndt.
Holotype (HeRB 3551) in the author's herbarium. Isotypes in QCR (Quito, Ecuador), the National Herbarium (Quito, Ecuador), and PUR.
This *Uredo* most probably belongs to a species of *Ravenelia*. It does not fit any of the *Cassia* rusts known so far. The spore measurements come close to *Uredo cassiae-stipularis* Sydow described from Chile. The uredinia of *Uredo pasochoae* are subcuticular, however, whereas those of *U. cassiae-stipularis* are subepidermal.

Uraecium guanacastensis R. Berndt, sp. n. (Figs. 5, 8, 9)
Spermogoniis gregariis, amphigenis, minutis, subcuticularibus (type 7), maculis distinctis, incrassatis, rotundatis insidentibus, urediniosoris primariis circumdatis. **Urediniis primariis** spermogoniis consociatis, amphigenis, sparsis, subepidermalibus, in mesophyllo profundis, epidermide diu tectis, pulverulentis, brunneis, paraphysibus nullis. **Urediniosporis primariis** pedicellatis, ellipsoideis, irregulariter rugosis-verruculosis, pallide ochraceis, 35-44 x 20-26 μm (circiter 41 x 23 μm), episporio 2-3 μm crasso, membrana ad apicem (5-) 6-8 (-10) μm crassa, poris germinationis (4-) 5 (-6), (sub-) equatorialibus, saepe membrana minor rugosa circumdatis.
In foliis *Pithecellobii longifolii* (H. & B.) Standley (Mimosaceae).
Spermogonia amphigenous, minute, subcuticular (Type 7), in dense groups on small, slightly hypertrophied round spots, surrounded by primary uredinia. **Primary uredinia** associated with the spermogonia, amphigenous, scattered, subepidermal, deep-seated in the leaf mesophyll, covered by the rather persistent epidermis, pulverulent, brown, without paraphyses. **Primary urediniospores** pedicellate, ellipsoid, irregularly and profusely rugose to warty, spores more or less ochraceous, 35-44 x 20-26 μm (on mean 41 x 23 μm), spore wall 2-3 μm thick, at the apex up to (5-) 6-8 (-10) μm, germ pores (4-) 5 (-6), (sub-) equatorial, often surrounded by less rugose or almost smooth areas of the spore surface.
On leaves of *Pithecellobium longifolium* (H. & B.) Standley (Mimosaceae).
Costa Rica, Prov. Guanacaste, Bagaces, Refugio de Vida Silvestre "Lomas de Barbudal", at the pond near the visitors center, 26. Mar. 1991, leg. R. Berndt.
Holotype (HeRB 2634) in the author's herbarium. Isotypes in CR (San Jose, Costa Rica) and PUR.
Pithecellobium spp. are hosts of several *Ravenelia* and *Uredo* spp. and two spp. of *Chaconia* and *Maravalia*. *Uraecium guanacastensis* differs from other rust fungi on *Pithecellobium* by the strongly rugose-warty, large primary urediniospores with a very thick apex. It may belong to a *Ravenelia* species.

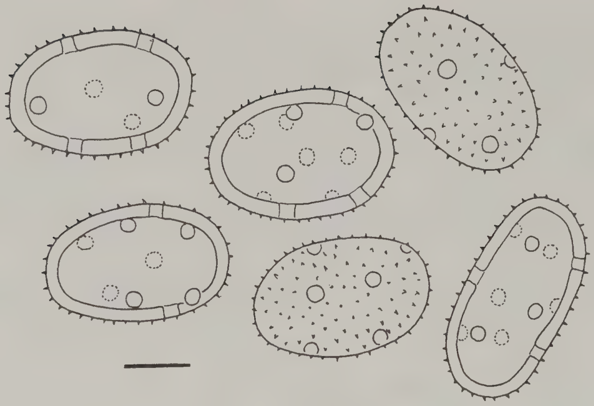


Fig. 4: *Uredo pasochoae*. Urediniospores. Scale bar = 10 μm.

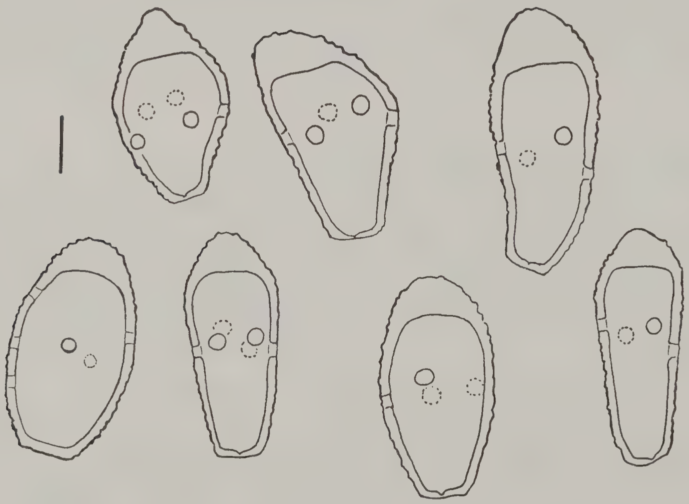


Fig. 5: *Uraecium guanacastensis*. Primary urediniospores. Scale bar = 10 μm.

Ravenelia verrucata Cummins & Baxter **var. *apurensis*** R. Berndt, var. n. (Figs. 6, 10)

Urediniis amphigenis, sparsis, subcuticularibus, paraphysatis, brunneis. **Urediniosporis** late ellipsoideis usque subglobosis, flavis, dense, minuteque echinulatis, 18-22 x 15- 19 μm (circiter 20 x 17 μm), episporio 1-2 μm crasso, poris germinationis (9-) 10-12 (-13), dispersis. **Paraphysibus** clavatis, 50-60 x 9-13 μm (in capitis), plus minusve hyalinis, ad apicem claro brunneis, membrana ± 1 μm crassa, ad apicem vix crassior (usque 4μm).

Soris teleutosporiferis atro-brunneis, uredosoris similis, subcuticularibus, paraphysibus nullis. **Capitulis teleutosporarum** orbicularibus, hemisphaericis, (55-) 60-70 (-75) μm diametr., ex sporis 4-5 in omni directione compositis, obscure castaneo-brunneis, sporis omnibus (6-) 7-9 (-11) papillis robustis, obtusis, hyalinis

(2-) 3 (-4) μm longis obsitis. Cystidiis semipendulis, eodem numero quo teleutosporis marginalibus.

In foliis *Mimosae schrankioidis* Benth. (Mimosaceae).

Uredinia amphigenous, scattered, subcuticular, paraphysate, brown. **Urediniospores** broadly ellipsoid to subglobose, yellowish, densely and finely echinulate, 18-22 x 15-19 μm (on mean 20 x 17 μm), spore wall 1-2 μm thick, germ pores (9-) 10-12 (-13), scattered. **Paraphyses** clavate, 50-60 x 9-13 μm (in the heads), wall about 1 μm thick, at the apex hardly thicker, rarely up to 4 μm.

Telia amphigenous, blackish brown, subcuticular, without paraphyses. **Teliospore heads** orbicular, hemisphaerical, (55-) 60-70 (-75) μm in diameter, 4-5 spores in cross-section, dark chestnut-brown, each spore with (6-) 7-9 (-11) strong, blunt, hyaline papillae of (2-) 3 (-4) μm length. Cysts semipendulous, of the same number as the marginal spores.

On leaves of *Mimosa schrankioides* Benth. (Mimosaceae).

Venezuela, state of Apure, road from Mantecal to San Fernando de Apure, at the dirtroad turnoff to Achaguas, 5. Dec. 1993, leg. R. Berndt.

Holotype (HeRB A-70) in the author's herbarium. Isotypes in VEN (Caracas), VIA (Maracay) and PUR.

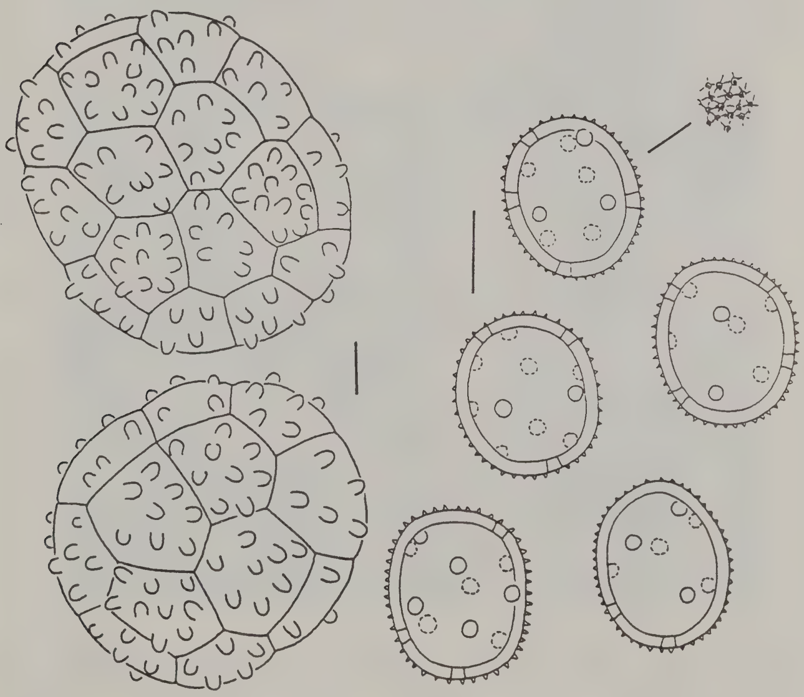
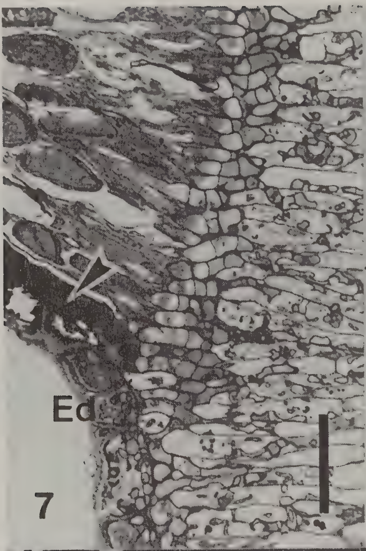
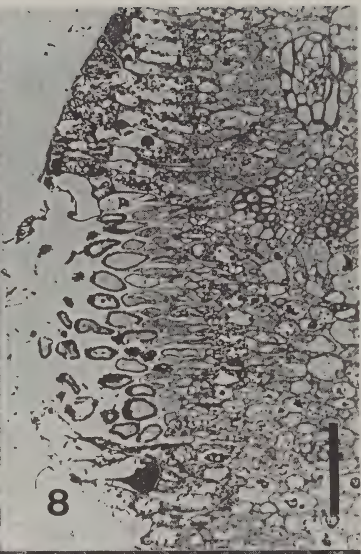
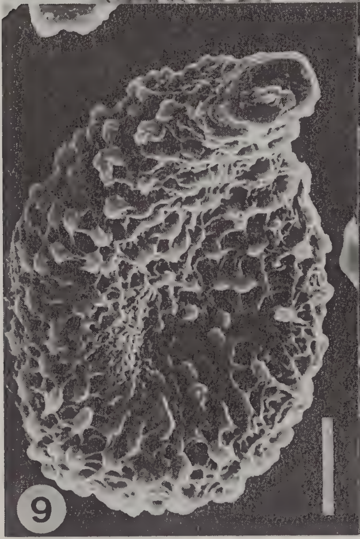


Fig. 6: *Ravenelia verrucata* var. *apurensis*. Teliospore heads and urediniospores. On the right a detail of the urediniospore surface pattern as seen in light microscope. Scale bars = 10 μm.







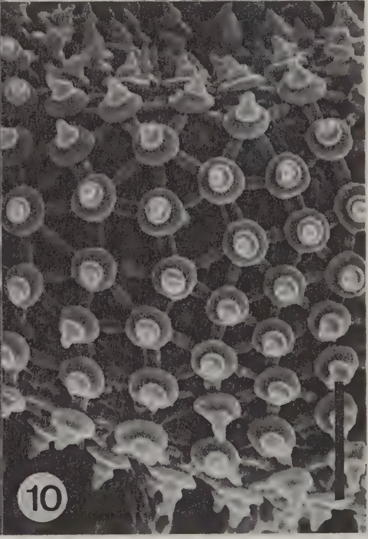


Fig. 7: Semithin section through a uredinium of *Uredo santa-rosensis*. The uredinium is covered by the ruptured host epidermis (Ed). On the inner side of the epidermis a deeply staining layer of fungal material can be discerned (arrowhead). Scale bar = 50 μm.

Fig. 8: Semithin section through the deep-seated primary uredinium of *Uraecium guanacastensis*. Scale bar = 80 μm

Fig. 9: *Uraecium guanacastensis*. SEM micrograph of primary urediniospore with irregular warts connected by shallow bridges. Scale bar = 5 μm

Fig. 10: *Ravenelia verrucata* var. *apurensis*. SEM micrograph of urediniospore with turret-like warts connected by regularly arranged spokes. Scale bar = 2 μm

Ravenelia verrucata is quite similar to *R. mimosae-sensitivae* P. Hennings. It differs by the thin-walled paraphyses, the thicker-walled urediniospores which have more germ pores, and the higher number of papillae on the teliospore surface. The present specimen from Venezuela appears to be identical with *R. verrucata* in respect of telial characters and morphology of the paraphyses (Cummins & Baxter, 1975). The urediniospores, however, have thinner walls and fewer germpores and thus resemble urediniospores of *R. mimosae-sensitivae*. The Venezuelan specimen is therefore intermediate between *R. verrucata* and *R. mimosae-sensitivae*. This may indicate that *R. verrucata* and *R. mimosae-sensitivae* are not sharply delimited. *R. mimosae-sensitivae* is known to be quite a variable species, and several Ravenelias and *Uredo* spp. that have been described as distinct (e.g., *R. mimosae-albidae* Dietel, *R. mimosae-caeruleae* Dietel, *R.* [*Uredo*] *mimosae-pudicae* Kern, Thurst. & Whetz., *R. mimosicola* Arthur, *R. sensitiva* Speg., *Uredo sensitiva* Speg., *U. asumptionis* Speg.) are now thought to be synonyms of *R. mimosae-sensitivae*. A thorough revision of the Ravenelias of the *mimosae-sensitivae*-complex is needed, therefore, to clear up the status of the different species. For the present *R. verrucata* var. *apurensis* is proposed as a new variety of *R. verrucata*, to take into account the differences in urediniospore morphology.

The elaborate pattern of the urediniospore ornament (Fig. 10) which can also be found in *R. mimosae-sensitivae* urediniospores (R. Berndt, unpubl. results) and in other Ravenelias (Gardner & Hodges, 1985; López-Franco & Hennen, 1989) has not been described for *R. verrucata*.

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NOVELTIES OF THE LICHEN FAMILY CLADONIACEAE IN CHILE AND ARGENTINA

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Abstract. *Cladonia confragosa* Stenroos, sp. nova, is described. *C. anserina* Ahti, *C. granulosa* (Vainio) Ahti, *C. robbinsii* A. Evans, and *C. subdelicatula* Asah. are new reports for Chile. *C. umbricola* Tonsberg & Ahti is a new report for Chile and Argentina and *C. floerkeana* (Fr.) Flörke for Argentina. *C. testaceopallens* var. *athallina* Räs. is a new synonym of *Metus pileatus* (Mont.) D.J. Galloway & P. James.

Key words: Chile, Cladoniaceae, lichens

In the course of preparation of the flora of Chilean Cladoniaceae (Stenroos 1995), several noteworthy findings were made which deserve to be discussed in more detail. The purpose of this paper is to give the most important results. The coming flora will present the morphology, chemistry, ecology, distribution (incl. maps) and nomenclature of each taxon more thoroughly.

No specific effort has been made to sum up literature because an exhaustive bibliography of Chilean lichenology has recently been published by Galloway & Marticorena (1991). Among the subsequent relevant publications to be mentioned here are those of Stenroos et al. (1992), Stenroos & Ahti (1992), Ahti (1993) and Stenroos (1993).

The study is based on material and observations accumulated during my field work in Chile in 1986-1987, 1989 and 1991-1992. A substantial amount of herbarium material was also studied, mainly from BM, FH, FH-Dodge, H, MB, MSC, S, SGO, TNS, UC, UPS and others.

Cladonia anserina Ahti

Ann. Bot. Fennici 29: 68. 1992. - Type: Falkland Islands. East Falklands, Goose Green, Fish Creek, alt. 6 m, *Empetrum* heath, bare peat, 1963 *R.W.M. Corner 83* (AAS, holotype; H, isotype).

New to Chile and Argentina. *Cladonia anserina* belongs to section *Helopodium* where it has been placed because of its clavate, striate to fibrose podetia

(Stenroos & Ahti 1992). It is uncommon in southern South America being found only in three localities, in addition to the Falkland Islands. The original material contains fumarprotocetraric and stictic acids but two new specimens represent a new chemotype, containing only the fumarprotocetraric acid complex containing chemotype. It is also possible that some of the specimens cited under *C. acuminata* (Ach.) Norrlin by Stenroos et al. (1992; chemotype five and probably also chemotype four, which contains atranorin besides fumarprotocetraric acid) belong to *C. anserina*. Two specimens from Chiloé containing atranorin and norstictic and stictic acids (*Santesson 4043, 4120*, S) belong either to *C. acuminata* or *C. anserina* but the specimens are extremely poor and and cannot be determined reliably. The specimen collected by Cunningham (see below) was earlier reported as *C. 'lamarkii* (Del.) Nyl.' (Crombie 1877); *C. lamarckii* Nyl. is actually a synonym of *C. ramulosa* (With.) J.R. Laundon.

Specimens examined: Chile. Magallanes, Puerto del Hambre, 1867 *Cunningham* (BM); Magallanes, Isla Riesco, Mina Elena, 1940 *Santesson 8102* (S). Argentina. Tierra del Fuego, Depto. Ushuaia, Bahía Lapataia, 1989 *Ahti 47734* (H).

Cladonia confragosa Stenroos, spec. nova (Fig. 1)
Thallus primarius squamulosus. Podetia usque ad 6 cm longa, cinerea vel fusco- albescentia, basi nigricantia, simplicia vel ramosa, vulgo scyphosa, superficie granulosa, microsquamulosa, hymenia rufa. Acidum fumarprotocetraricum et atranorinam (inconstanter) continens.

Type: Chile. Valdivia, Corral, on naked earth in open place in rain forest, 1940 *R. Santesson 2317* (S, holotype; H, isotype).

Primary thallus persistent to evanescent, consisting of up to 3 mm long, sparsely lobate squamules. Podetia up to 8 cm tall, grayish to brownish-white, blackening at base, simple or branched laterally or by proliferating scyphi, generally with scyphi but in part subulate, sometimes flexuose, podetial wall entire, stereome and medulla well-developed. Surface of podetia coarsely granulose immixed with granulose soredia and microsquamules, larger squamules often numerous, present especially on older podetia, interior of scyphi granulose sorediate. Scyphi gradually flaring, up to 6 mm wide. Hymenial discs on margins of scyphi, brown. Conidiomata on margins of scyphi, containing hyaline slime. Chemistry: Fumarprotocetraric acid, traces of protocetraric, convirensic and confumarprotocetraric acids. Atranorin inconstant.

The taxon now described as *C. confragosa* was erroneously treated as *C. verruculosa* (Vainio) Ahti by Ahti & Kashiwadani (1984). True *C. verruculosa* (Ahti 1978), which can be found in North America, can be distinguished from *C. confragosa* by commonly centrally proliferating scyphi (not present in *C. confragosa*) and by not being richly squamulose. Moreover, *C. verruculosa* never produces atranorin. Both species have blackening basal parts and

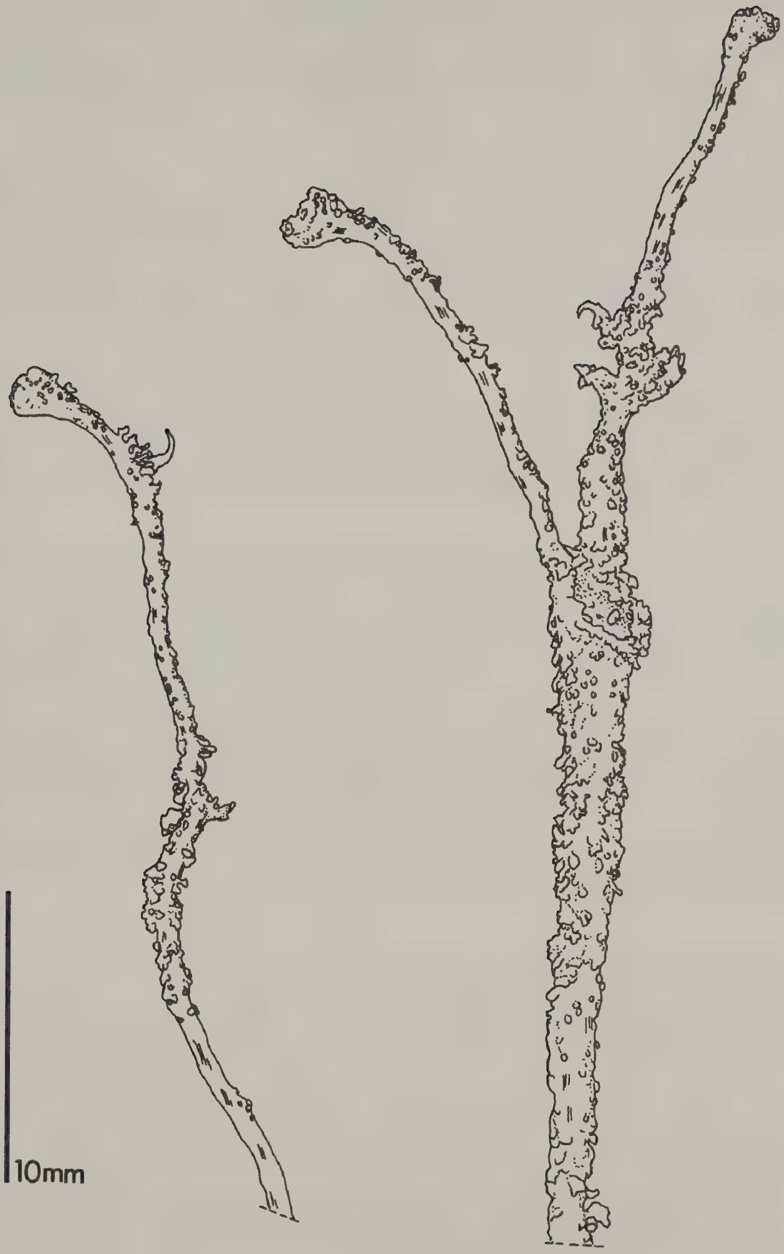

Fig. 1. *Cladonia confragosa* Stenroos (from holotype, S).

produce fumarprotocetraric acid. *C. confragosa* has been found from the provinces Curico, Nuble, Cautín, Valdivia, Osorno, Llanquihue, Chiloé, Coihaique, Ultima Esperanza and Tierra del Fuego in Chile, and in the provinces Chubut and Santa Cruz in Argentina. It grows on soil, boulders and rotten wood in various forests and open habitats like heaths and roadside scrub. *C. confragosa* belongs to section *Cladonia*.
Selected specimens examined (paratypes): Chile. Valdivia, Collico, 1940 *Santesson 8317* (S); Llanquihue, Machihue, Río Llico, 1981 *Kashiwadani 17941* (TNS); Coihaique, Cerro Divisaderos, 1940 *Santesson 4427* (S); Ultima Esperanza, Natales, Cerro Dorotea, 1940 *Santesson 2177* (S). Argentina. Chubut, P. Nac. Los Alerces, Lago Cisne - Lago Menéndez, 1991 *Hyvönen 5466* (H); Santa Cruz, P. Nac. Los Glaciares, S of Lago Onelli, 1991 *Hyvönen 5016* (H).

Cladonia floerkeana (Fr.) Flörke
De Cladon.: 99. 1828 (*"Floerkiana"*). - *Cenomyce floerkeana* Fr., Lich. Suec. Exs. no. 82. 1824, nom. nudum; Sched. Crit. Lich. Suec. 1-4: 18. 1825. - Type: Sweden. *E.M. Fries*, Lich Exs. Suec. 82 (UPS; Ahti 1993).

New to Argentina. *Cladonia floerkeana* has not been correctly reported from South America before. It is apparent that *C. floerkeana* s.str. (coarse, corticate, definitely esorediate) is restricted to Europe and eastern North America in the Northern Hemisphere, as suggested by Stenroos & Ahti (1994). Stenroos (1994) tentatively reports *C. floerkeana* for South Africa. The species would therefore exhibit a strictly bipolar distribution. Two specimens found from South Shetland Is. and South Orkney Is. and discussed under *C. weymouthii* by Stenroos (1993) need to be checked but they possibly belong to *C. floerkeana* as well. The Argentine specimen cited below contains barbatic, 4-O-demethylbarbatic and didymic acids.

Specimen examined: Argentina. Tierra del Fuego, Depto. Ushuaia, 16 km NE of Ushuaia, W of Rancho Hambre, 1989 *Wedin 1129* (UPS).

Cladonia granulosa (Vainio) Ahti
Ann. Bot. Fennici 23: 205. 1986. - *Cladonia subsquamosa* var. *granulosa* Vainio, Acta Soc. Fauna Fl. Fennica 4: 448. 1887. - Type: Colombia. Antioquia, Sonsón, *G. Wallis s.n.* (TUR-V No. 15142, lectotype; G, isolectotype).

New to Chile. *C. granulosa* is a South American endemic which has been reported from the upper Andean forests of Colombia and Venezuela (Ahti 1986). The Chilean material, erroneously reported as *C. chondrotypa* Vainio by Ahti & Kashiwadani (1984), clearly belongs to *C. granulosa*. *C. granulosa* is c. 10 cm tall, brownish- to whitish-grey, subulate and branches by proliferations around scyphoid openings. Its surface is granulose sorediate. *C. granulosa* belongs to section *Perviae* and contains thamnolic acid. *C. granulosa* can be found in the area from Juan Fernández down to Magallanes.

Selected specimens examined: Chile. Valdivia, Collico, 1940 *Santesson 3258* (S); Aisén, N of Puerto Cisnes, near Fjordo Quelat, 1991 *Hyvönen 5350* (H).

Cladonia robbinsii A. Evans
Trans. Connecticut Acad. Arts 35: 611. 1944. - Type: USA. Connecticut, Lyme, 1931 *A. Evans 2625* (US).

New to Chile. *C. robbinsii* rarely produces podetia but its conspicuous, yellow primary squamules are readily observed. This primarily North American species (Thomson 1968) was recently reported as new to South America from Rio Grande do Sul, Brazil (Fleig et al. 1995). *C. robbinsii* belongs to section *Foliosae* and contains usnic, barbatic and 4-O-demethylbarbatic acids.

Specimen examined: Chile. Valparaíso, Lago Peñuelas, on bare soil on dry slope, 1940 *Santesson 3103* (S)

Cladonia subdelicatula Asah.
J. Japanese Bot. 38: 1. 1963. - Type: Brazil. Rio Grande do Sul, Mun. Venâncio Aires, Faxinal Tamanco, 1909 *C. Jürgens 5735 (135)* (TUR-V 15098a, holotype; FH, US, isotypes).

New to Chile. *C. subdelicatula* was previously only known from SE Brazil, ranging from Minas Gerais to Rio Grande do Sul (Fleig et al. 1995), and from Paraguay (Ferraro et al. 1994). *C. subdelicatula* is confined to shady and moist forests, growing on rotten wood and trunk bases. It may be easily overlooked because it tends to produce only primary squamules and podetia are sometimes infrequent. *C. subdelicatula* belongs to section *Perviae* and contains thamnolic acid.

Specimen examined: Chile. Valdivia, Collico, 1940 *Santesson 8320* (S).

Cladonia umbricola Tonsberg & Ahti
Norwegian J. Bot. 27: 307. 1980. - Type: Norway. Sor-Trondelag, Klaebu, Ramgåa SW of Selbusjoen, 1976 *R. Hjelmstad s.n.* (TRH, holotype; BM, H, O, UPS, isotypes).

New to Chile and Argentina. *C. umbricola*, formerly only known from oceanic forests of NW Europe and western North America (Tonsberg & Ahti 1980) is now reported, though with some hesitation, from southern South America. It is very close to *C. ustulata* (J.D. Hooker & Taylor) Leighton, a very common lichen in the area, but can be distinguished from the latter by very narrow scyphi and slender, small podetia. The presence of squamatic acid in the Chilean and Argentine specimens conforms with the northern populations. *C. umbricola* belongs to section *Cocciferae*.

Specimens examined: Chile. Osorno, Puyehué, 1947 *Sparre 2141* (S). Argentina. Chubut, P. Nac. Los Alerces, Cerro Dedal, 1991 *Hyvönen 5446b* (H).

Metus pileatus (Mont.) D.J. Galloway & P. James
Notes RBG Edinburgh 44: 571. 1987. - *Cladonia pileata* Mont., Ann. Sci. Nat., Bot., sér. 3, 18: 310. 1852. - Type: Chile. (Coquimbo?), *C. Gay s.n.* (PC-Mont., lectotype; H-NYL, isolectotype).

Cladonia testaceopallens Vainio var. *athallina* Räs., Revista Univ. (Santiago) 22: 209. 1937, syn. nov. - Type: Chile. Valdivia, Coreltué, ad corticem *Eucryphia cordifoliae*, 1928 *P.A. Hollermayer 1110* (H, holotype; H, UC 677469, isotypes).

Cladonia testaceopallens var. *athallina* is reduced here to a synonym of *Metus pileatus*. *M. pileatus* grows in moist forests and has been found in the Coquimbo region, and in Prov. Juan Fernández, Cautín, Valdivia, Llanquihue, Chiloé, Aisén and Magallanes in Chile. The species is easily overlooked and may therefore be more widely spread than is now known.

ACKNOWLEDGEMENTS

Prof. Ahti kindly suggested amendments to the manuscript. This work was financed by the Academy of Finland.

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INGOLDIOMYCES, A NEW GENUS OF USTILAGINALES *

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ABSTRACT

A new genus of Ustilaginales, Tilletiaceae, *Ingoldiomyces* K. Vánky is proposed. The type, *I. hyalosporus* (Massee) K. Vánky, comb. nov., is based on *Tilletia hyalospora,* on various *Nassella* and *Stipa* species (Gramineae). *Ingoldiomyces* is characterised by sori in ovaries of Gramineae, spores single, basidia aseptate producing apically one or two, large "ballisto basidiospores" which may produce secondary ballisto-spores or hyphae on which further ballistospores and filamentous, curved, aerial blastoconidia may arise on sterigmata. The septal pore is a dolipore without pore caps. Haustoria or intracellular hyphae are lacking. The genus is related to the *Tilletia – Neovossia – Conidiosporomyces – Oberwinkleria* group. A key for these genera is given. Lectotype is selected for *Tilletia hypsophila* Speg. (= *I. hyalosporus*).

INTRODUCTION

Smutted specimens of *Nassella* species (Gramineae, subfam. Pooideae, tribe Stipeae) were recently collected in Ecuador and Venezuela by the senior author. The study of this smut fungus, which was identified as *Tilletia hyalospora* Massee, disclosed peculiar and unique spore wall morphology, and a type of spore germination resulting in "ballisto basidiospores" which are different from all known *Tilletia* species and of known genera of Ustilaginales (comp. Ingold, in press; Vánky, 1987; Vánky & Bauer, 1992 & 1995).

MATERIALS AND METHODS

Material used for spore germination, sorus, spore wall structure and septal pore studies was collected on *Nassella mexicana* (Hitchc.) Pohl in Venezuela, Estado Mérida, Cordillera de Mérida, Aquila Pass, alt. 3670 m, 28.XI.1993, R. Berndt, C. & K. Vánky (HUV 16417), distributed in Vánky, Ust. exs. No. 930.

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* Part 122 in the series "Studies in Heterobasidiomycetes" from the Botanical Institute, University of Tübingen.

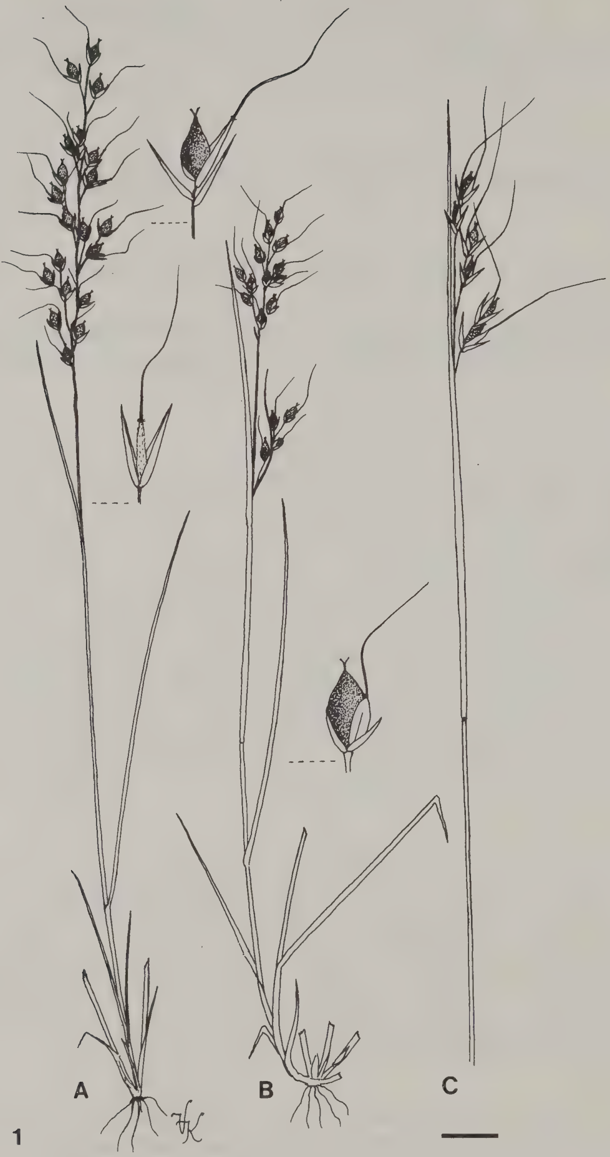

Fig. 1. Sori of *Ingoldiomyces hyalosporus* (Massee) K. Vánky.
A. On *Nassella mexicana* (Hitchc.) Pohl (Venezuela; Vánky, Ust. exs. No. 930; HUV 16417). Enlarged a healthy and an infected spikelet. **B.** On *Nassella chilensis* (Trin. & Rupr.) Desv. (Ecuador; HUV 15775). Enlarged an infected spikelet. **C.** On *Stipa lepida* Hitchc. (USA; HUV 5476). Bar = 1 cm.

For light microscopical (LM) studies, dried spores were rehydrated in lactophenol by gently heating to boiling point. For scanning electron-microscopical (SEM) studies, dried spores were dusted on double-sided adhesive tape, mounted on specimen stub, sputter-coated with gold-palladium, ca. 20 nm, and examined in a SEM at 10 kV.

For studies of soral and ultrastructural characters, freshly collected young sori were fixed in 2% glutaraldehyde in 0.1 M Na-cacodylate buffer at pH 7.2 for several days. After six transfers in 0.1 M Na-cacodylate buffer, the material was postfixed in 1% osmiumtetroxide in the same buffer for 1 h in the dark, washed in distilled water, and stained in 1% aqueous uranyl acetate for 1 h in the dark. After five washes in distilled water, the material was dehydrated in acetone series, embedded in Spurr's plastic and sectioned with a diamond knife. Semi-thin sections were stained with new fuchsin and crystal violet, mounted in "Entellan" and studied in a light microscope. Ultra-thin sections were mounted on copper-slot-grids, post-stained with lead citrate for 5 minutes, and examined in a TEM at 80 kV.

For the study of germination, spores were spread thinly on water agar, on 0.2% or 2% malt agar in Petri dishes kept at room temperature (ca. 20 °C). When germination started, (after 5–6 days), the lid of the dishes was removed to obtain a greater gradient of humidity which favours production of basidiospores. As soon as basidiospores were produced, a suitable piece of medium (about 10 mm square) was cut out, transferred to a slide, and covered with a coverglass. A small droplet of lactophenol with cotton blue added to the side of the square of medium, fixed and stained the basidia and basidiospores. To show the nuclei in the basidia and basidiospores, Giemsa staining was used (as described in Bauer, 1978:113).

Ingoldiomyces K. Vánky, **gen. nov.**

Sori in ovariis Graminearum, tumefacti, e membrana externa origine matricali fungalique et e massa centrali sporarum mixta cum cellulis sterilibus compositi. Columella, conidia inter sporas odorque trimethylamini massarum sporarum absentes. Sporae solitariae, pallide coloratae, cum ornamentatione. Germinatio sporarum in basidiis aseptatis, ad sterigmata "ballisto-basidiosporas" paucas, magnas, arcuatas efficiens. Typus pororum septalium doliporus sine pileo. Hyphae parasiticae intercellulares; hyphae intracellulares et haustoria absentes. Typus generis: *Ingoldiomyces hyalosporus* (Massee) K. Vánky.

Sori in ovaries of Gramineae, swollen, composed of an outer membrane of host and fungus origin, and a central mass of spores mixed with sterile cells. Columella, groups of conidia between the spores, and smell of trimethylamine of the spore masses are absent. Spores solitary, pale coloured, ornamented. Spore germination results in aseptate basidia on which apically, on sterigmata, a few, large, bent "ballisto basidiospores" are produced. Septal pore type is a dolipore without pore caps. Parasitic hyphae grow intercellularly; intracellular hyphae and haustoria absent. Typus generis:

Ingoldiomyces hyalosporus (Massee) K. Vánky, **comb. nov.**
Basionym: *Tilletia hyalospora* Massee, Bull. Misc. Inform. 1899:148, 1899. — Type on *Piptochaetium* sp. (= *Nassella pubiflora* (Trin. & Rupr.) E. Desv.), Bolivian Andes, near Sorata, ca. 11500 ft, G. Mandon (Plantae Andium Boliv. No. 1275; NY!).

Tilletia hypsophila Spegazzini, 1902:59. — Lectotype (selected here) on *Stipa caespitosa* (Griseb.) Speg. (= *Nassella caespitosa* Grieseb.), Argentina, in the high mountains between Tucuman and Salta, "Pampas grande, Salta", XII.1896 (LPS 3678!). Syntype on *Stipa tenuissima* Trin., Argentina, between Tucuman and Salta, XII.1897 (LPS 4076!, as on *Stipa* sp.).

Tilletia wilcoxiana Griffiths, 1904:88. — Lectotype on *Stipa eminens* Cav. var. *andersonii* Vasey (= infected plants of *Stipa lepida* Hitchc.), USA, California, Santa Monica, 5.IV.1895 (in Griffiths as "April 1902"), H. E. Hasse (BPI 173929!; Lectotype sel. by Vánky, 1990:476, ex errore as BPI "173930" instead of 173929). Syntype on *Stipa lepida* Hitchc., USA, California, Santa Monica, spring 1901, H. E. Hasse (BPI 173924!).

Tilletia boliviensis Liro, 1935:1 (nomen nudum); 1939:113. — Type on *Nassella pubiflora* (Trin. & Rupr.) E. Desv., Bolivia, Larecaja Prov., near Sorata, Lancha de Cochipata, cliffs above Choquecoa, alt. 3200–3700 m, 9.XII.1858, G. Mandon, Plantae Andium Boliv. 1275; H! (ex S, phanerogam herb.), HUV 2302!

Sori (Fig. 1) in ovaries, swollen, ovoid to ellipsoidal with a short, acute tip bearing the rest of the stigma, 1–2 x 1.5–3 mm, composed of a membrane and a central, semipowdery mass of spores intermixed with sterile cells. Columella and groups of conidia between the spores are absent. Sorus membrane first green, later pale or dark brown, composed of an outer layer of pericarp tissue and a thin, internal layer of hyphae which disappears in mature sori. Spore mass pale yellowish-brown to reddish-brown, semipowdery, lacking smell of trimethyl-

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Figs. 2–4. Spores and sterile cells of *Ingoldiomyces hyalosporus* (Massee) K. Vánky (Type). Bars = 10 µm.

Fig. 2. Spores in LM, in surface view, and a sterile cell (arrow). Note the typical spore surface ornamentation and the pale colour of the spores.

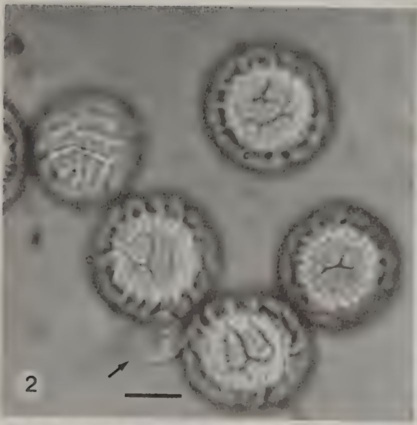
Fig. 3. Spores in LM in optical median view.

Fig. 4. Spores and a damaged sterile cell (arrow) in SEM. The finest spore ornaments are covered by the dried gelatinous spore sheath.

Figs. 5–7. Spore wall and septal pore of *Ingoldiomyces hyalosporus.* (Vánky, Ust. exs. No. 930; HUV 16417).

Figs. 5, 6. Spore wall structure of sectioned young (Fig. 5) and mature spores (Fig. 6) in TEM. PW = primary wall, SW = secondary wall, P = protoplasm, PM = plasmalemma, RI = ridge initial, F = substance of foamy to fibrous structure. EX = exospore, EN = endospore, PL = partition layer, BL = basal layer of the exospore, R = ridge, S = sheath (For description see the text). Bars = 1 µm.

Fig. 7. Median section through a septum showing (in TEM) a typical dolipore without pore caps, with bandings in the pore channel. Bar = 0.1 µm.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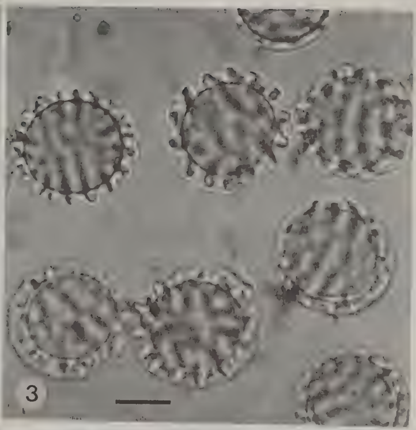
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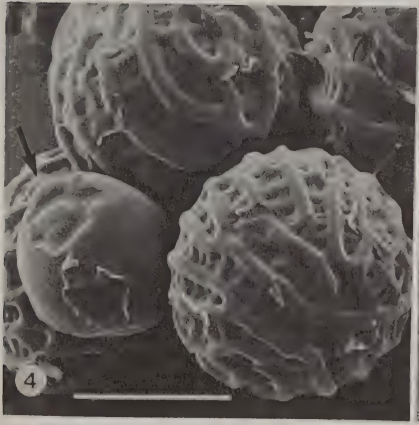
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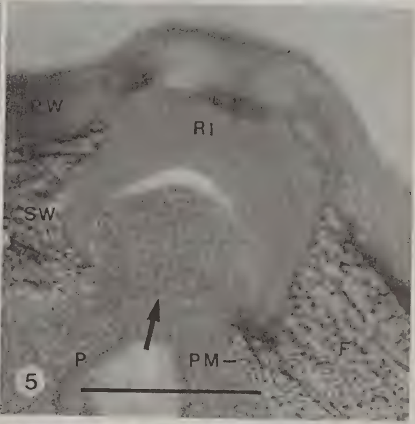
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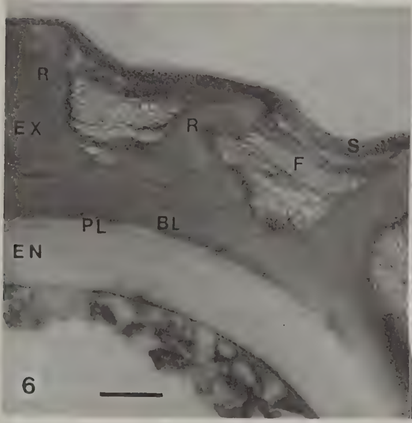
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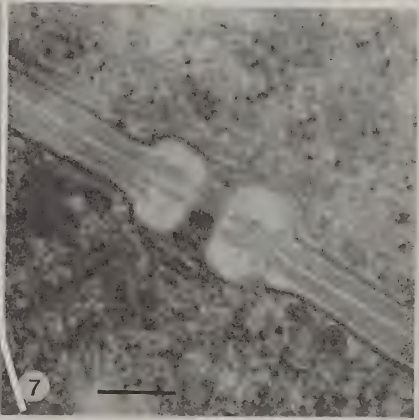
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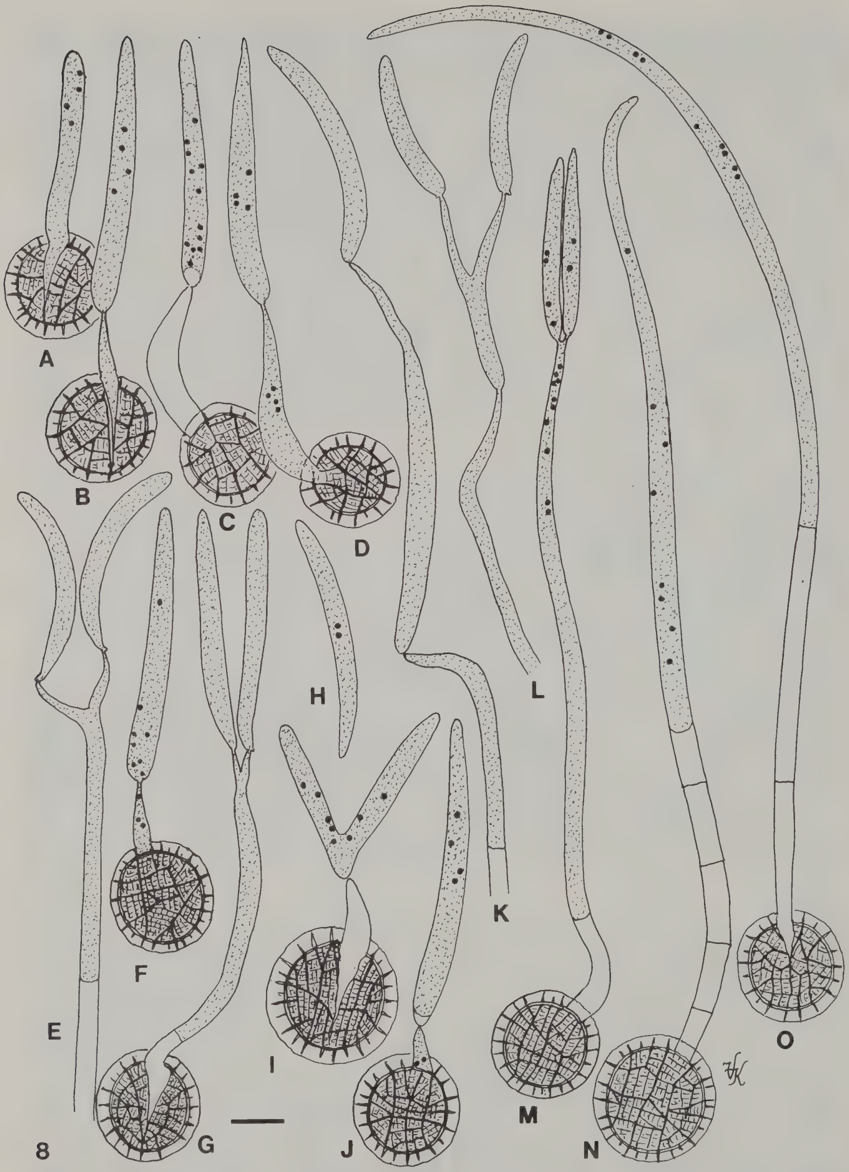

Figs. 8, 9. Spore germination of *I. hyalosporus* (HUV 16417). Bars = 10 µm. Fig. 8. **A.** Young basidium. **N, O.** Older basidia, developed under coverglass, with empty proximal part and retraction septa. **B, C, D, F, J.** Basidia each with one basidiospore. **E, G, L, M.** Basidia each with two basidiospores. **I.** Y-shaped spore developed on a basidium under drier conditions. **H.** A basidiospore with 2 nuclei. **K.** Top of a basidium with a basidiospore which on its distal part produced a further, basidiospore-like spore.

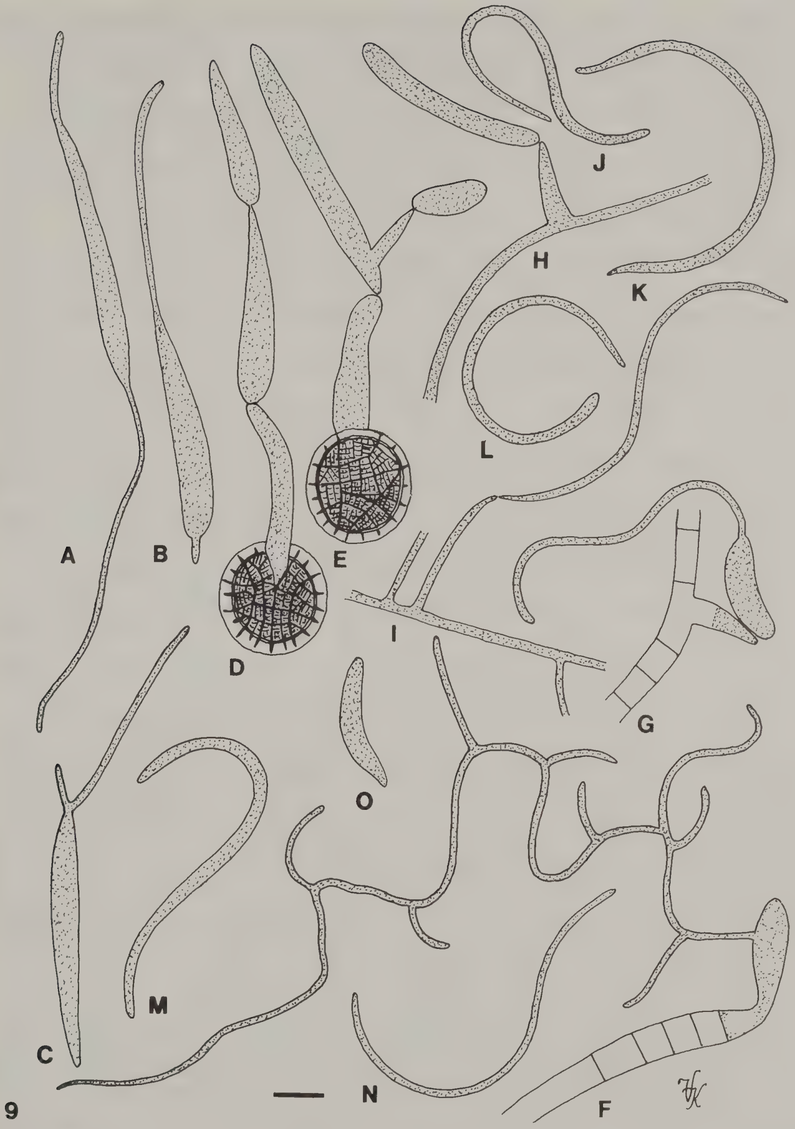

Fig. 9. **A, B, C.** Germinating basidiospores. **D.** Germinated spore with a basidiospore bearing a basidiospore-like spore on its top. **E.** Germinated spore with a basidiospore producing a ballistospore on a well-developed sterigma. **F.** Ramified mycelium produced by (? rest of) a basidium. **G.** Germinating ballistospore produced on a lateral sterigma of a thick hypha (? rest of a basidium). **H.** A large, basidiospore-like ballistospore produced on a thin hypha. **I.** Aerial, thin, curved blastoconidium produced on a long, lateral sterigma on ramified hypha. **J, K, L, M, N.** Blastoconidia. **O.** A ballistospore.

amine. Infection systemic. All seeds of an infected plant are affected. Infected plants may be stunted. Rarely may some shoots of an infected plant escape infection. Spores (Figs. 2–4) solitary, globose, subglobose to ellipsoidal, 16–22 x 18–24 µm, including the 2–4 µm thick sheath, subhyaline to pale yellowish-brown, peculiarly ornamented by a few coarse ridges which run parallel on the spore surface, or more commonly ramify and anastomose to form an irregularly reticulated pattern. These coarse ridges are joined by finer, narrow, short, secondary ridges which, in their turn, may be connected by very fine tertiary ridges, visible only under LM by high magnification (under SEM, the fine surface ornamentation is hidden by the dried spore sheath). Spore wall 3–5 µm thick, including the thin (ca. 0.8–1 µm) endospore, the coarsely ornamented exospore, and the well-developed hyaline sheath which generally extends just beyond the spore ornamentation. In optical median view (Fig. 3) the primary, coarse ridges appear as 1.5–3.5 µm high, subacute to acute spines, 0.8–1.2 µm wide at their base. The secondary ridges are about half of the height and width of the primary ones, and the tertiary ridges are about half as high and wide as the secondary ones. Occasionally, a short, thin, hyaline appendage, the remainder of the sporogenous hypha, can be seen attached to the spores. Sterile cells (Figs. 2, 4) globose, subglobose to ellipsoidal, smaller than the spores (8–14 x 8-16 µm); wall 0.5–3 µm thick, hyaline, smooth; content homogenous or finely granular, subhyaline to pale yellowish-brown. Spore germination (Figs. 8, 9) results in shorter or longer, 3–4(–5) µm wide, aseptate basidia. On the top of basidia, on sterigmata, one, more rarely two, bent, hyaline, aerial "ballisto basidiospores" are produced measuring 5–6.5 x 30–75 µm. Some basidiospores may produce a further, basidiospore-like spore on their distal end (Fig. 8 K) or, supposedly (not directly observed), a second basidiospore may be produced also on the top of basidia from the remaining protoplasm and nuclei, after the first basidiospore was released. The basidiospores germinate, usually at both ends (Fig. 9 A, B, C), giving rise to highly branched, thin (ca. 1.5 µm wide) hyphae or, on well-developed sterigmata, small, secondary ballistospores arise from the basidiospores (Fig. 9 E). In cultures, ramified hyphae, which resulted from basidiospore germination and growth (Fig. 9 F), produced shorter or longer lateral sterigmata (Fig. 9 H, I). On these, filamentous, curved, C-shaped, sigmoid, loop-like aerial blastoconidia were formed (Fig. 9 I, J, K, L, M, N) measuring 2-4 x 55–100 µm. They germinate to give a germ-tube or a ballistoconidium (Ingold, in press). Ballistospores were also produced on hyphae (Fig. 9 H), germinating to give rise to thin hyphae. Short basidia usually have four nuclei, the older, long ones usually eight. Basidiospores usually have 4 nuclei, but 2 to 12 nuclei were also observed. Basidiospores with 12 nuclei will probably produce further basidiospore-like spores. A basidium which was producing two basidiospores simultaneously, one with 4 and the other with 2 nuclei, still had 10 nuclei (Fig. 8 M). Under relatively dry conditions, Y-shaped spores were produced on the top of basidia (Fig. 8 I). The time from production of Buller's drop at the hilar appendix of the basidiospores, until discharge of the spores, was ca. 15 seconds.

Ingoldiomyces hyalosporus is known from a few places from North- and South America on *Nassella* E. Desv., *Piptochaetium* J. S. Presl, and *Stipa* L. species (Gramineae, subfam. Festucoideae, tribe Stipeae): *Nassella caespitosa* Grieseb. (*Stipa caespitosa* (Grieseb.) Speg.), Argentina; *N. chilensis* Desv., Ecuador; *N. mexicana* (Hitschc.) Pohl (*Stipa mexicana* Hitchc.), Venezuela; *N. pubiflora* (Trin. & Rupr.) E. Desv., Bolivia; *Piptochaetium montevidense* (Spreng.) Parodi, Argentina; *Stipa inconspicua* Presl, Argentina; *S. lepida* Hitchc. (*S. eminens* Cav. var. *andersonii* Vasey), USA; *S. tenuissima* Trin., Argentina; ?*Stipa* sp., Peru. These three grass genera are closely related and the limits between them are not always sharp. The geographic distribution of *I. hyalosporus* is certainly much larger than that known at present and it is probably not rare in the high mountains of South- and Central America. A specimen of "*Tilletia hypsophila* Speg.", however, on *Stipa* sp. from Australia, Queensland, Odine between Morven and Mitchell, 31.III.1936, coll. S. T. Blake (HCIO 10369!), is *T. texana* Long.

The strongly convolute and indurate, awned lemma, which encloses the seed in healthy plants, is open and more or less membranaceous in infected flowers (see Fig. 1 A, enlarged spikelets). The same phenomenon was observed in *Panicum maximum* L., infected by *Conidiosporomyces ayresii* (Berk.) K. Vánky (Vánky & Bauer, 1992:428). In that case, both the indurate lemma and palea of the fertile flower, which are enclosing the seed, are open and not indurated in the infected flowers.

Spore wall structure, host parasite interaction, septal pore.

In young spores the spore wall (Fig. 5) is composed of an outer primary wall (PW), corresponding to the wall of the sporogenous hyphae, and an inner, secondary wall (SW). In some areas, the protoplasm (P) with its plasmalemma (PM) protrudes into the secondary wall (arrow). Ridge initials (RI) appear as uniformly dense material forming above and on the sides of the protrusions of the plasmalemma. The space between the ridges (F) has a loose, foamy to fibrous structure. In mature spores the spore wall (Fig. 6) is composed of a wide exospore (EX), a narrow endospore (EN) and a thin, undulate partition layer (PL) between them. The exospore has a thin, dark (electron-dense) basal layer (BL), and a wider, medium dark layer from which the different categories of ridges (R) arise, having the same density and homogeneity. The space between the ridges (F) is lighter and has a finely foamy to fibrous structure. The outermost layer of the exospore is a dark, thin, continuous layer, the remnant of the primary wall, which (probably) represents the sheath (S). The parasitic hyphae are intercellular, lacking haustoria. The septa have a central dolipore without pore caps. Note the bandings in the pore channel (Fig. 7).

DISCUSSION

Based on the common septal pore structure (dolipore without pore caps), and also other characters, *Ingoldiomyces* belongs to the *Tilletia* group with *Tilletia* L.-R. & C. Tulasne, *Neovossia* Körnicke, *Conidiosporomyces* K. Vánky, and

Oberwinkleria K. Vánky & R. Bauer (comp also Vánky & Bauer, 1995:367). However, in *Ingoldiomyces*, on the top of basidia, ballisto basidiospores are produced (one or two) a unique feature within the Ustilaginales. Another unusual feature is the fact that the hilar appendices of the paired, curved basidiospores usually face away from the longitudinal axis of the basidium (comp. also Ingold, in press). This kind of basidiospore is common for *Exobasidium* species, and has been observed in only a few smut fungi (unpublished data). It is also unique in the Tilletiaceae that basidiospores may be produced both simultaneously and successively on the same basidium (indirect observation).

External conditions may markedly influence spore germination and also the result of the germination in smut fungi. Under coverglass, or in very humid conditions, germinating spores of *Ingoldiomyces hyalosporus* produced long basidia without basidiospores. When the coverglass or the lid of the Petri dishes was removed, the long basidia usually simultaneously produced two aerial ballisto basidiospores. In less humid conditions, the basidia were shorter and usually only one basidiospore was produced. On rather dry substrates, on the top of basidia, a "Y" shaped spore was commonly produced. Whereas humidity strongly influenced the result of germination, the three media tested, apparently had no influence on the rate of germination, or morphology of basidia and basidiospores.

It is remarkable that, for a smut fungus with such a peculiar and unique spore morphology, there are three taxonomical synonyms (not counting a further, unpublished herbarium name). In fact, *Tilletia hyalospora* Massee and *T. boliviensis* Liro are based on the same collection: Mandon, Plantae Andium Boliv. No. 1275. These names were published because the authors did not know about the existence of earlier published names or, they did not compare the type specimens. Undoubtedly, there are rather large variations between different collections of *I. hyalosporus* regarding the colour of the spore masses (not only depending on the degree of the maturity of the spores), or the size and ornamentation of the spores. E. g., the type of *Tilletia wilcoxiana* on *Stipa lepida* has smaller (17–21.5 μm long) and more finely ornamented spores than the type of the species, and the spore wall (including the sheath) in this specimen is also thinner (2.5–3.5 μm). At the same time, another specimen on *Stipa lepida* (USA, California, Berkeley Hills, IV.1925, H. E. Parks 3055; HUV 5476!) has spores more or less identical with the type of *I. hyalosporus*. There are also variations in the coarseness of the ridges and the thickness of the hyaline sheath of the spores between different South American collections. Because of all intermediate forms, these differences must be considered as variations within the same species.

This genus is named in honour of the outstanding British mycologist, Professor Emeritus C. Terence Ingold, who was the first to germinate this fungus like he did with so many other smut fungi, and also realised that "It is difficult to see how *T. hyalospora* can be retained in *Tilletia*". Furthermore, this genus is a token of a long co-operation and friendship with the senior author, and is a present for Terence for his 90th birthday on 3rd of July, 1995.

Key to the genera of the *Tilletia* group.

1. Basidia reduced to the spores .... *Oberwinkleria*
– Basidia present 2
2. Groups of conidia present between the spores .... *Conidiosporomyces*
– Groups of conidia absent between the spores 3
3. Basidiospores few (1–2), ballistosporic .... *Ingoldiomyces*
– Basidiospores more (4–80), not ballistosporic 4
4. Spores foveolate, with long appendage .... *Neovossia* s. str.
– Spores otherwise sculptured, without long appendage .... *Tilletia*

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ECTOMYCORRHIZAE OF ALBATRELLUS OVINUS (SCUTIGERACEAE) ON NORWAY SPRUCE WITH SOME REMARKS ON THE SYSTEMATIC POSITION OF THE FAMILY*

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Abstract: The ectomycorrhizae of *Albatrellus ovinus* are comprehensively described and compared to those of Gomphidiaceae, Thelephoraceae ss. Stalpers and Bankeraceae ss. Stalpers. The most striking features of *Albatrellus ovinus* ectomycorrhizae are (a) bifurcate cystidia originating from a net of mantle hyphae, (b) slight amyloidity of thicker walls of hyphae and distinctly amyloid septa, (c) blue granules in and on hyphae of mantle and rhizomorphs. Similar characteristics could be shown at and in the stipe base of the fruitbody. A possible closer relationship between Thelephorales and Scutigeraceae is discussed.

Key words: *Albatrellus ovinus*, amyloidity, anatomy, ectomycorrhizae, elemental micronalysis (EELS), *Picea abies*, Scutigeraceae, systematics, Thelephorales, ultrastructure

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* Considered as part LXI of the series "Studies on ectomycorrhizae"; part LX: Agerer (1995)

Introduction

To date, amyloid reactions of ectomycorrhizae could be found in two different families.

First records regard the Gomphidiaceae. Ectomycorrhizae of *Chroogomphus rutilus* (Schff.: Fr.) O. K. Miller have been proven to possess slightly amyloid globular cells in the mantle and amyloid parts of its mycorrhizal cystidia (Agerer 1990). *Chroogomphus helveticus* ssp. *tatrensis* (Pilat) Kuthan & Sing. was shown to produce slightly amyloid cystidial tips and distinctly amyloid emanating hyphae (Agerer 1990). *Gomphidius glutinosus* (Schff.) Fr. is characterized by slightly amyloid globular mantle cells, distinctly amyloid septa in inner mantle surface, slightly amyloid young cystidia, and by partially amyloid rhizomorph hyphae (Agerer 1991a). Lastly, *Gomphidius roseus* (L.) Fr. has similar features with respect to amyloidity as *G. glutinosus*, but amyloid globular cells are lacking (Agerer 1991a). *Gomphidius maculatus* (Scop.) Fr. ectomycorrhizae fit roughly to those of *G. glutinosus*, those of *G. gracilis* Bk. & Br. ss. Bres. to those of *Chroogomphus helveticus* ssp. *tatrensis* (Agerer, in prep.).

Surprisingly, ectomycorrhizae of some Thelephoraceae ss. Stalpers (1993), too, turned out to possess partially amyloid ectomycorrhizae. This is true of *Thelephora terrestris* Pers.: Fr., where basal septa of cystidia as well as parts of hyphae of inner mantle layers are amyloid (Agerer 1991a), of *Tomentella albomarginata* (Boud. & Galz.) M. J. Larsen with slightly amyloid cap-like structures of rhizomorph hyphae (Agerer 1995a), and of *Pseudotomentella tristis* (P. Karst.) J. M. Larsen which produces amyloid septa in emanating hyphae (Agerer 1994). Even on emanating hyphae of a member of Bankeraceae ss. Stalpers (1993) small amyloid patches could be found (*Boletopsis leucomelaena* (Pers.: Fr.) Fayod: Agerer 1992a). Ectomycorrhizae of other Bankeraceae, however, did not show amyloidity (Agerer 1991c, 1993).

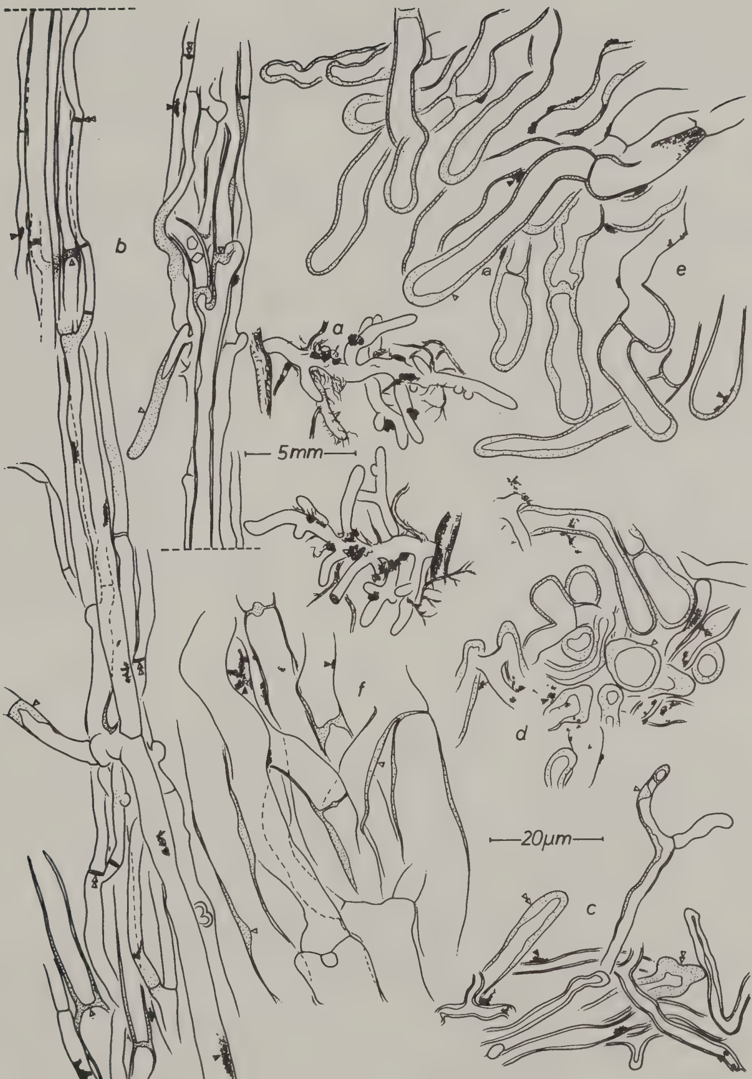
As it is known that some *Albatrellus* species, especially *A. ovinus* (Schff.: Fr.) Kotl. & Pouz., forms amyloid stipe base hyphae (Jülich 1984), it was of special interest to study its mycorrhizae.

Material and Methods

Methods for characterizing ectomycorrhizae have been previously explained by Agerer (1986, 1987-1994, 1991b), and a glossary of terms has already been published (Agerer 1987-1994). The sections have been studied after embedding in Historesin and cutting to 5 µm thick slices. The fungus was determined using Jülich (1984).

The methods for ultrastructural studies and for elemental microanalysis (electron energy loss spectroscopy, EELS) on hyphal inclusions were previously described (Agerer et al. (1994, Franz 1994, Franz & Acker 1995a), those for the detection of thelephoric acid by Agerer et al. (1995). Chemical analysis was done with 7 g freeze-dried stipes of the following material: *Albatrellus ovinus*, Germany, Bavaria, Müncheh, Pupplinger Au, 7. 9. 1993 (in M). Fruitbodies of *Punctularia* (s. discussion): *P. tuberculosa* Pat. ad truncos *Olea europaea*, Lumia, leg. et det. C. Torrend I-09, (C. Torrend-Mycotheca Lusitanica, M).

Fig. 1. - a. Habit of ectomycorrhizae. - b. Young (thin) rhizomorph drawn in two portions; dashed lines indicate points of continuation. - c. Surface view of older (thicker) rhizomorph. - d. Plan view of mantle surface, with nest of roundish cells. - e. Stipe base of fruitbody, outer portions with caulocystidia. - f. Stipe base of fruitbody, hyphae below caulocystidia. All. figs. from RA 11778. (b-d: in Melzer's reagent; dots and open arrowheads: amyloid structures, double arrowheads indicate more intense amyloidity; dark patches and closed arrowheads: blue granules).


b
a
e
a
5mm
f
d
20µm
c

Results

Anatomical-morphological results

Albatrellus ovinus (Schaeff.: Fr.) Kotl. & Pouz.

Reference specimen: Germany, Bavaria, vorderer Bayerischer Wald, Lkr. Regensburg, near Forstmühle, in Waldbezirk Rabenzipfl, on *Picea abies* roots, leg. R. Agerer, 3. 10. 1992; fruitbody and mycorrhizae in herb. R. Agerer RA 11778 (in M).

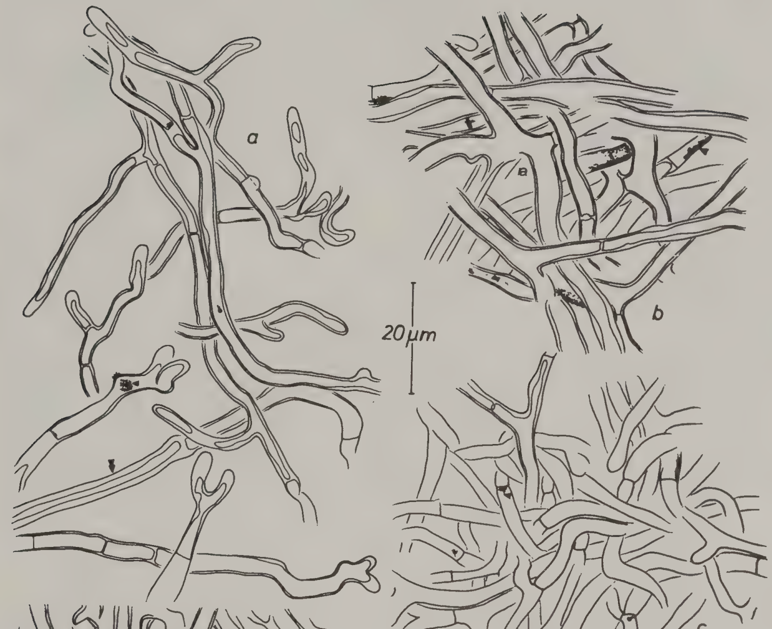
Morphological characters (Fig. 1a)

Mycorrhizal system up to 11 mm long, monopodial-pyramidal or more infrequently monopodial-pinnate, often forming dense clusters; unramified ends straight to bent, at most slightly sinuous, up to 2 (-4) mm long and 0.33-0.45 mm in diameter; axes 0.45-0.75 mm in diameter; surface of unramified ends loosely stringy to densely woolly, with distinct mantle surface, no cortical cells shining through, with silvery appearance due to air trapped between the mantle hyphae; rhizomorphs abundant, up to 0.3 mm in diameter (near mycorrhiza), roundish in cross-section, emanating in the middle part of the mycorrhiza or proximally, connection to mantle rather distinct or dividing into few thicker cords, colour of rhizomorphs like those of mycorrhizae and with the same colour changes with age, ramification more or less monopodial, in part forming nets, rhizomorphs close to fruitbodies rather thick and due to short blunt ends often resembling a mycorrhiza, frequently ramifying; ultimate ends of the rhizomorphs often dichotomous, margin mostly smooth but occasionally woolly; unramified ends with a thin white layer on a blackish background, later the white layer becoming reddish brown, very tips greyish brownish, in part with a violet tint, older parts or older mycorrhizae at first turning to dark brown, later to black.

Anatomical characters of mantle in plan views (Figs. 1d, 2)

Outer surface of mantle (Figs. 1d, 2a, b) below cystidia plectenchymatous (mantle type D after Agerer 1991b, 1987-1994), no pattern discernable, hyphal cells irregularly bent and curved, plasmatically and membranaceously slightly brownish, partially with blue pigment on hyphal surface (in water), occasionally with blue granules (in water) occurring in the cells, hyphae smooth, (2-)3-3.5(-4) µm in diameter, walls 0.5 (-1) µm thick, sometimes unevenly thickened, cell length variable, mantle with patches of roundish, inflated cells, 10-20 x 6-9 µm, walls (0.5-)1-2 µm thick; thicker walls slightly amyloid, often in a patchy manner, septa frequently with globular or lens-shaped amyloid thickenings, sometimes also blue granules (in water) at the septa, these becoming darker in Melzer's reagent. *Middle layers of mantle* (Figs. 2c) more densely plectenchymatous than outer layers, no pattern discernable, hypha less bent, occasionally somewhat inflated, (2.5-)3-4.5(-6.5) µm in diameter, walls mostly 0.5 µm thick, smooth, some hyphae with walls up to 1(-1.5) µm, less coloured than hyphae of outer layers, amyloidity less distinct. *Inner surface of mantle* (Figs. 2d) densely plectenchymatous, with gelat-

Fig. 2. - a. Cystidia of mantle. - b. Plan view of mantle just below cystidia. - c. plan view of mantle, middle hyphal layers. - d. Plan view of inner mantle surface. - e. Plan view of mantle surface of very tip. All figs. from RA 11778. (amyloidity not indicated; dark patches and solitary closed arrowheads: blue granules; double arrowhead: emanating hypha).


a
b
20 µm
c
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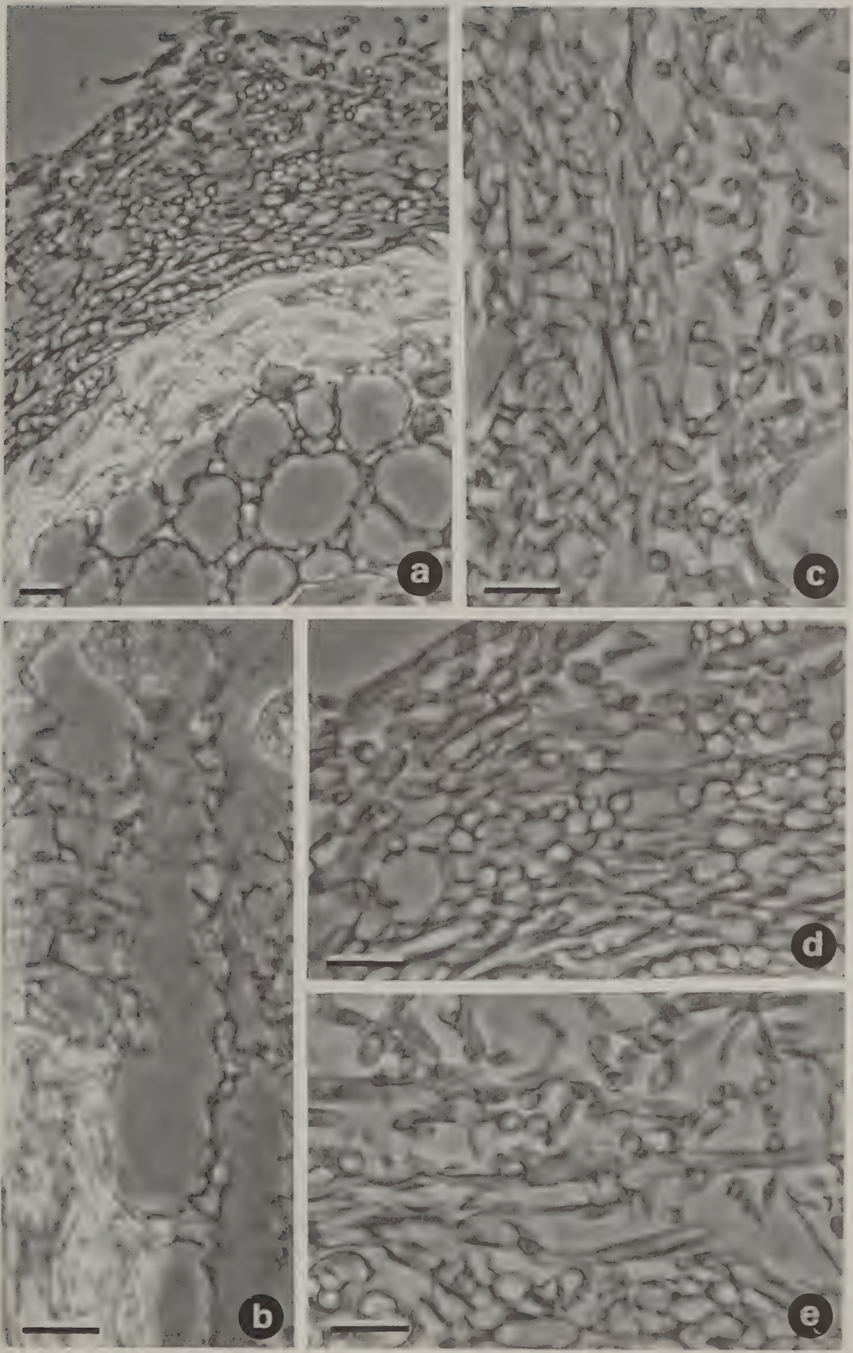
e

inous matrix, hyphae 3.5-4.5(-5.5) μm diameter, not inflated, walls rather thick, walls of adjacent hyphae closely united, walls 0.5-1(-2) μm thick, cell length variable, membranaceously brown, occasionally with densely arranged blue granules (in water), hyphae with some slightly amyloid wall portions or merely some septa amyloid. *Surface of very tip* (Figs. 2e) plectenchymatous, gelatinous, hyphae arranged almost star-like, 2-3 μm in diameter, thin-walled, septa slightly thicker, smooth, mostly membranaceously and plasmatically slightly brownish, emanating hyphae darker brown, hyphae of mantle in part membranaceously bluish-green (in water), behind the very tip already with thick-walled cystidia-like hyphae of ca. 3.5 μm diameter, walls irregularly thick, thin or up to 1.5 μm thick. *Rhizomorphs* (Figs. 1b, c) up to 150 μm thick, slightly differentiated (rhizomorph type D after Agerer 1991b, 1987-1994), nodia lacking, margin of rhizomorph with many emanating hyphae and cystidia, some hyphal ends with cap-like thickenings, hyphae densely arranged, some thicker hyphae occurring, these not centrally arranged, (4.5-)5.5-7.5(-9) μm in diameter, walls 0.5-1(-1.5) μm thick, membranaceously brownish, some hyphal cells densely filled with homogeneous brownish contents, septa mostly simple, distance of septa 36-180 μm, thick hyphae very infrequently with clamps; remaining central hyphae of the rhizomorphs 2.5-3.5(-4) μm in diameter, with simple septa, distance of septa 5-35 μm, plasmatically and membranaceously brown, walls thin or up to 0.5 μm thick, smooth, some peripheral hyphae very thin (1-1.5 μm in diameter) with densely aggregated blue granules (in water), other peripheral hyphae 2-3 μm in diameter, walls ca. 0.5μm thick, smooth, sometimes with patches of roundish cells, cystidia with thick walls (s. below). *Emanating hyphae* (Fig. 2a) 2-3(-3.5) μm in diameter, walls up to 0.5(-1) μm thick, smooth, membranaceously brown, septa simple, in part with lens-shaped and even globular central thickenings, distance of septa 18-45 μm, blue granules (in water) within hyphae and on their surface, distal ends in part with cap-like thickenings, intrahyphal hyphae occurring, anastomoses simple, very infrequently with a septum. *Cystidia* (Fig. 2a) smooth, colourless, mostly forked, occasionally with three branches, sometimes also irregularly ramified, distal ends blunt and frequently very thick-walled (cap-like), total length of cystidia (20-)35-35(-50) μm, unramified part 2-2.5 μm in diameter, branches (4-)10-20(-25) μm long and 2-2.5 μm in diameter, walls unevenly thick, 0.5-1(-1.5) μm thick, opposite walls frequently deviating in thickness (one side 0.5 μm, other side 1.5 μm), inside with blue granules (in water), slightly amyloid.

Anatomical characters, longitudinal section (Figs. 3b, c, e)

Mantle 40-60(-70) μm thick, plectenchymatous throughout, inner layers densely plectenchymatous, comprising ca. 2/5 of mantle thickness, outer 3/5 loosely arranged, remnants of calyptra cells as irregularly shaped lines, next to tannin cells, hyphae of outer mantle layers tangentially 2.5-20(-40) μm, radially 2.5-4 μm, walls thin, hyphae of inner layers of mantle (2.5-)3-15(-25) μm, radially (2.5)3-4(-8) μm, walls 0.5 μm thick; mantle of very tip 45-60 μm thick, two layers discernable, inner half of mantle densely plectenchymatous, outer half loosely plectenchymatous, hyphal cells roundish to cylindrical, as in the remaining parts of the mantle, outer part with hyphae tangentially 3-20 μm, radially

Fig. 3. - a. Cross-section, from outer mantle layers to endodermis. - b. Longitudinal section, Hartig net in section and in plan view. - c. Longitudinal section, mantle of very tip. - d. Cross-section, mantle from outer layers (above) to inner layers (below). - e. Longitudinal section, mantle from outer layers (above) to inner layers (below). All figs. from RA 11778. Bars represent 10 μm.


a
c
b
d
e

2.5-3 μm, inner part with hyphae tangentially 3-10 μm, radially 2.5-3.5 μm. *Tannin cells* in 2-3 rows, irregularly shaped, elliptic to cylindrical to biconcave, oriented approximately in parallel to root surface, tangentially (27-)35-85(-105) μm, radially 3-10(-12) μm, TCt = 56.3 μm, TCq = 9.4. *Cortical cells* irregularly elliptic to cylindrical to biconcave, oriented in parallel or slightly obliquely to root surface, tangentially (40-)55-112(-130) μm, radially (8-)10-20(-27) μm, CCt = 79.5 μm, CCq = 6.3. Hartig net in plan view infrequently and irregularly lobed, lobes (1.5-)2.5-5(-6) μm broad.

Anatomical characters, cross-section (Figs. 3a, d)

Mantle structure corresponding to longitudinal section; hyphae of outer portion tangentially 3-30(-60) μm, radially (2-)2.5-4(-5) μm, cell walls thin or up to 0.5 μm thick, hyphae of inner portion tangentially (3-)15-30 μm, radially (2-)2.5-4(-5) μm; residues of calyptra cells irregularly shaped, very slender, close to tannin cells. *Tannin cells* irregularly slender, tangentially-oval to -elliptic, strongly compressed by Hartig net, tangentially (8-)10-33(-50) μm, radially 3-9 μm, TCt = 19.9 μm, TCq = 3.9. *Cortical cells* roundish to tangentially- elliptic to -oval, tangentially (8-)12-31 μm, radially (6-)9-23 μm, CCt = 20.2 μm, CCq = 1.5. *Hartig net in section* around tannin cells 4-8 μm thick, in 1-2(-3) rows, round to oval, in part arranged to nests in corners between adjoining cells; around cortical cells (1.5-)2-3(-4) μm thick, in 1(-2) rows, two cells in corners between cortical cells, long cylindrical, in part wedge-shaped; Hartig net reaching endodermis.

Colour reaction with different reagents

Mantle and rhizomorph preparations: aniline: reddish grey, blue granules unchanged; ethanol 70%: n.r. (= no reaction), blue granules unchanged; formol 40%: n.r., blue granules unchanged; guaiac: n.r., blue granules unchanged; iron(II)sulfate: n.r., blue granules unchanged; KOH 15%: n.r., but walls of emanating hyphae in part swelling, blue granules unchanged; Lactic acid: ochre brown, blue granules unchanged; Melzer's reagent: in part amyloid (see mantle in plan views), blue granules turning to blackish blue; phenol: greyish blue, blue granules unchanged; phenol-aniline: slightly reddish, blue granules unchanged.

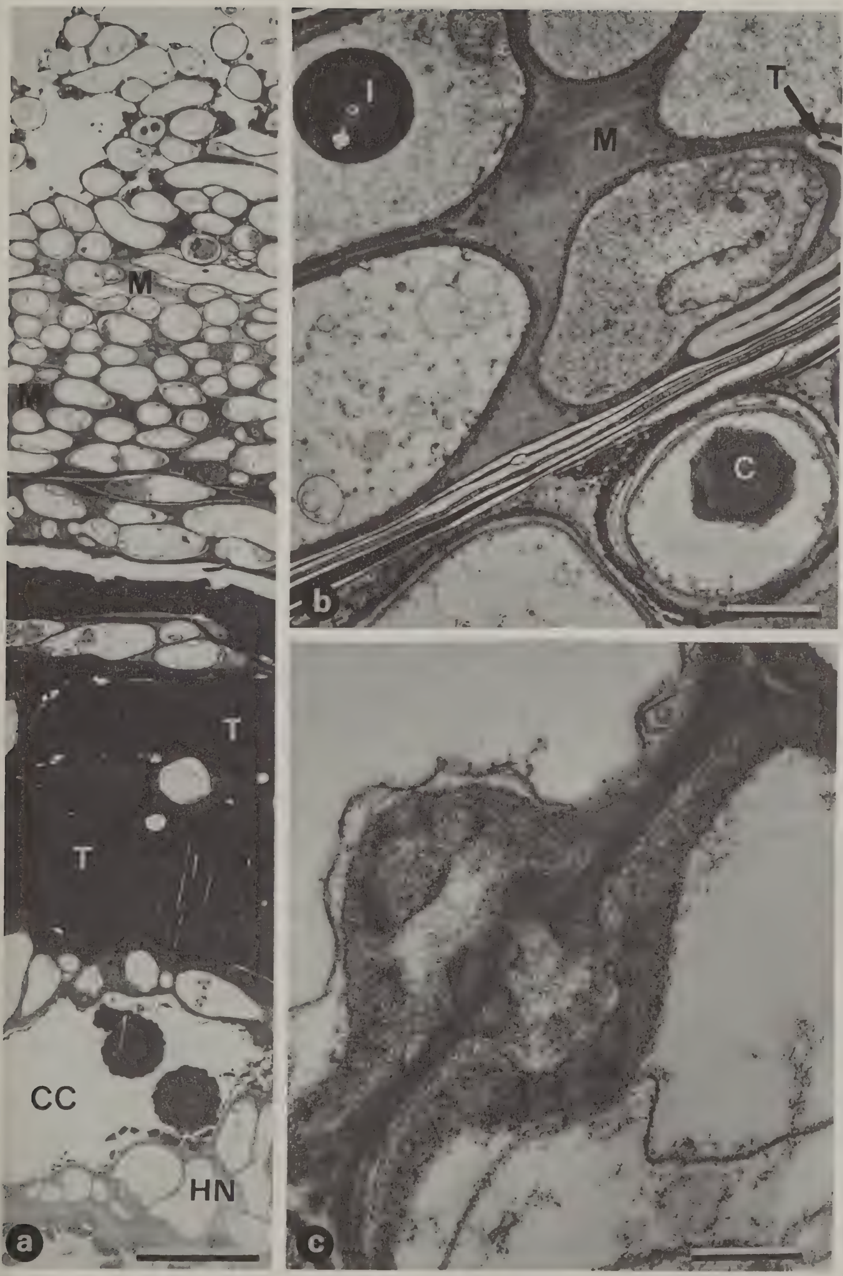
Autofluorescence

Whole mycorrhiza: UV 254 nm: lacking; UV 366 nm: lacking. *Mantle in section*: UV-filter 340-380 nm: mantle bluish green throughout; blue filter 450-490 nm: mantle slightly greenish yellow throughout; green filter 530-560 nm: slightly reddish throughout.

Staining of nuclei

Aceto-carmine: two nuclei per hyphal cell, mostly close together, distance 0-3 μm, ellipsoid, 1.5-2 x 1-1.5 μm, siderophilous granulations lacking.

Fig. 4. Electron micrographs of ultrathin sections. - a. Fungal mantle containing interhyphal matrix (M) surrounded by a network of loosely woven hyphae. Cortical cell (CC), Hartig net (HN), tannin (T). Bar represents 10 μm. - b. Part of fungal mantle in the contact area of mantle and Hartig net presenting the electron-dense interhyphal matrix (M) and hyphae with a globular, nitrogen containing inclusion (I) and a crystalline, nitrogen containing inclusion (C). Bar represents 1 μm. - c. Dolipore with perforated parenthesome. Bar represents 0.5 μm. All figs. from RA 11778.


M
M
T
T
CC
HN
a
I
M
T
C
b
c

Stipe base of fruitbody (Figs. 2e, f)

Stipe base with 13-45 µm long *caulocystidia*, distally 4-8 µm, proximally 4-5.5 µm thick, walls distally 0.5-2 µm thick, basally 0.5-1 µm, clamps lacking, walls slightly amyloid, contents of caulocystidia occasionally with blue granules (in water), such blue granules also occurring attached to surface of caulocystidia; *hyphae of stipe below cystidia* inflated, infrequently with clamps, cells 3.5-22 µm thick, unevenly thick-walled, occasionally up to 1.5 µm thick, septa sometimes thickened up to 1(-2) µm, not infrequently with a central, globular thickening; thickened walls slightly amyloid, cells in part covered with blue granules (in water).

Material studied and method of identification

Reference specimen. - Further material studied: Germany, Bavaria, vorderer Bayerischer Wald, Lkr. Regensburg, near Forstmühle, in Waldbezirk Rabenzipfl, on *Picea abies* roots, leg. R. Agerer, 30 9. 1992; fruitbody and mycorrhizae in herb. R. Agerer RA 11776 (in M); material not well developed.

Ultrastructural results

The hyphal mantle shows an electron-dense matrix (Figs. 4a, b) and is enveloped by loosely arranged hyphae. The Hartig net of all *Albatrellus ovinus* ectomycorrhizae investigated presented typical features of the Hartig net of spruce ectomycorrhizae described in detail (Nylund 1980, Haug 1987, Franz 1994).

The hyphae of the fungal mantle and the Hartig net are shown to contain two different nitrogen-containing inclusions, a globular type located in vacuoles (Fig. 4b, I), and a crystalline one (Fig. 4b, C). The occurrence of nitrogen in both inclusions has been proven by EEL spectroscopy. The EEL spectra obtained from such inclusions present the N_K edge (Fig. 5). All inclusions examined showing a similar ultrastructural appearance as shown in Fig 4b, revealed comparable EEL spectra, as presented in Fig. 5. Therefore, the inclusions mentioned are most probably protein accumulations, which were already described in previous works (Agerer et al. 1994, Franz 1994, Franz & Acker 1995a, 1995b).

The mycorrhizal hyphae form dolipore septa with a perforated parenthosome (Fig. 4c).

Chemical results

At least 10 compounds with more or less characteristic UV-spectra were extracted from the fruitbody of *Albatrellus ovinus* (Fig. 6 left side). One compound, eluded in our HPLC-system (Schmidt 1990, Agerer et al. 1995) after 25:08 min showed a UV-spectrum identical to that of thelephoric acid (no 5 in fig. 6 right side).

Discussion

Comparison with similarly shaped ectomycorrhizae of other fungi

Albatrellus ovinus is the first member of this genus and of the family Scutigeraceae being characterized with regard to its ectomycorrhizae. The most prominent features are: man-

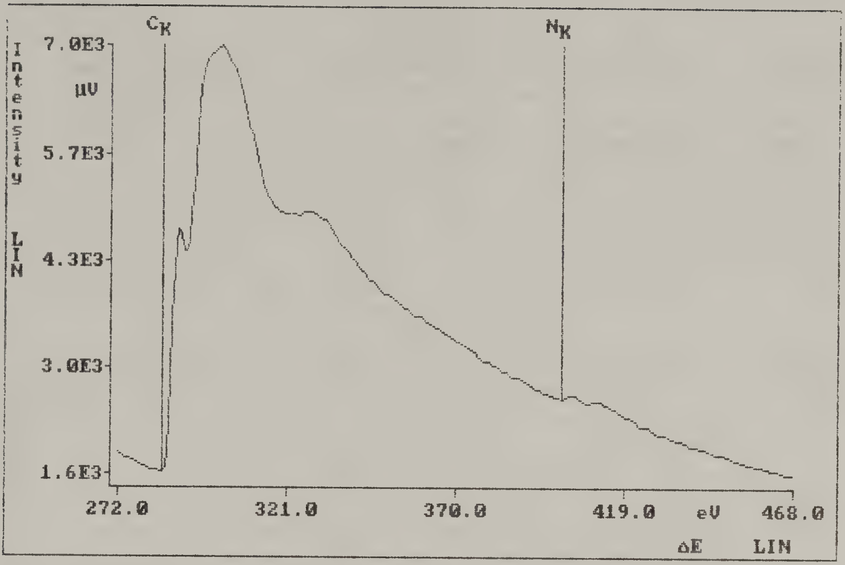


Fig. 5. - Electron Energy Loss (EEL) spectrum presenting the C_K and N_K edge. (From RA 11778).

tle of type D (Agerer 1987-1994, 1991b), rhizomorphs of type D (Agerer 1987-1994, 1991b), forked cystidia which are very similar to the awl-shaped type A (Agerer 1987-1994, 1991b), amyloidity and blue granules (in water) in or on the hyphae of the ectomycorrhizae.

As far as the anatomy of ectomycorrhizae is concerned, the closest similarities can be found in ectomycorrhizae of *Chroogomphus helveticus* and *C. rutilus* (Agerer 1990), *Gomphidius glutinosus* and *G. roseus* (Agerer 1991a), in *G. gracilis* and *G. maculatus* (Agerer, in prep.), and in *Thelephora terrestris* (Agerer & Weiss 1989). The ectomycorrhizae of these taxa possess mantles of type D (Agerer 1995b), they lack rhizomorphs (*Chroogomphus* spp.: Agerer 1990, 1995b) or produce those of type C (*Gomphidius* spp., *Thelephora terrestris*: Agerer 1991a, 1995b, Agerer in prep.). The rhizomorphs of type D formed by *Albatrellus ovinus* are not very different from type C rhizomorphs (see Agerer 1995b); in type C somewhat thicker hyphae are arranged approximately in the central part, whereas in type D they are randomly distributed. The cystidial shape is almost identical: straight (*Chroogomphus rutilus, Gomphidius glutinosus, G. maculatus, G. roseus, Thelephora terrestris:* Agerer 1990, 1991a, Agerer, in prep., Agerer & Weiss 1989), or bent or even curved (*Chroogomphus helveticus, Gomphidius gracilis*: Agerer 1990, Agerer in prep.), proximally partitioned off from the mantle cells by a clamp, abruptly thick-walled, with a smooth surface (Agerer 1990, 1991a, 1995b, Agerer in prep., Agerer & Weiss 1989). Although a large number of species from 48 fungal genera and from 24 fungal families are rather well known with respect to their ectomycorrhizae (Agerer 1995b), mantles of the type mentioned above have been unknown in other genera or families of fungal ectomycorrhiza formers (Agerer 1995b). Only the genus *Tuber* frequently forms similarly shaped cystidia (Fontana & Centrella 1967, Giraud 1979, 1990, Palenzona 1969, Rauscher et al. 1995, Zambonelli et al. 1993), and the mantles are

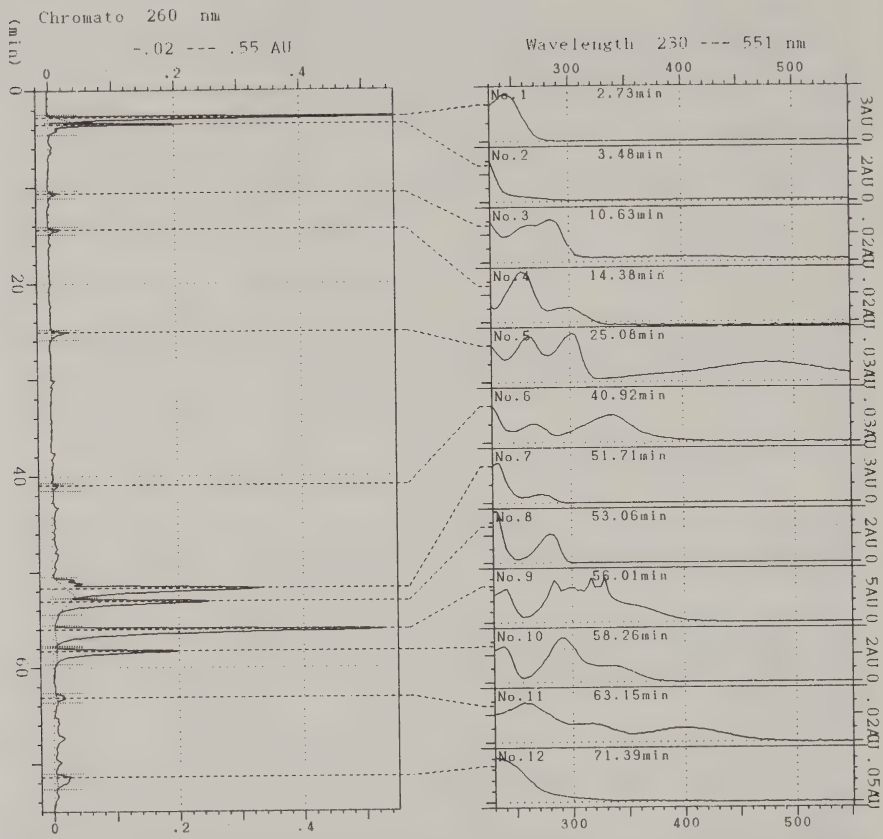


Fig. 6. - High performance Liquid Chromatography (HPLC) elution profiles of the extract of *Albatrellus ovinus* stipes and the corresponding UV-spectra of the individual peaks. Thelephoric acid elutes after 25.08 min.

occasionally of type D (Blaschke 1987), but mostly pseudoparenchymatous mantles are formed (Giraud 1979, 1990, Rauscher et al. 1995, Zambonelli et al. 1993).

To date all identified basidiomycetous ectomycorrhizae with such cystidia are known to form amyloid structures of the cystidia, and/or emanating hyphae and/or mantle hyphae and/or in rhizomorphs, and they belong to the genera *Chroogomphus* or *Gomphidius* (Gomphidiaceae), to *Thelephora terrestris* (Thelephoraceae ss. Stalpers) or to *Albatrellus ovinus* (Scutigeraceae). A few unidentified ectomycorrhizae, however, which are also formed by basidiomycetes and which have similar but clampless cystidia and different mantle types do not show amyloid reactions. This is true of "*Fagirhiza setifera*", "*F. spinulosa*", and "*F. pallida*" (Brand 1991). Some species of Thelephoraceae ss. Stalpers without cystidia (*Pseudotomentella tristis*: Agerer 1994; *Tomentella albomarginata* (Bourd. & Galz.) M. J. Larsen: Agerer 1995a) or of Bankeraceae ss. Stalpers (*Boletopsis leucomelaena*: Agerer 1992a) show amyloid reactions on their ectomycorrhizae. However, ectomycorrhizae of other Bankeraceae (*Bankera fuligineo-alba*:

Agerer & Otto in prep.; *Hydnellum peckii*: Agerer 1993; *Phellodon niger*: Agerer 1992b; *Sarcodon imbricatus*: Agerer 1991c) do not show amyloidity.

In addition amyloidity is known in fruitbodies of two other members of Thelephoraceae ss. Stalpers (*Pseudotomentella molybdea* Larsen 1983; *Tomentellago aeruginascens* Hjortstam & Ryvarden 1988), and in fruitbodies of some Bankeraceae ss. Stalpers (several *Hydnellum* spp. and *Sarcodon* spp: Harrison 1964). Their ectomycorrhizae are still undescribed and nothing is therefore known about possible amyloid reactions. Amyloidity within fruitbody hyphae is also found in some ectomycorrhizal genera of Boletaceae (*Gastroboletus* spec. and *Boletus* spp: Imler 1950, Miller & Watling 1967, Thiers in Miller 1971) as well as in few species of *Boletellus*, *Paragyrodon*, *Pulveroboletus*, and *Xerocomus* (Imler 1950), and in some species of *Rhizopogon* (Smith & Zeller 1966). Nothing is known about any amyloid reactions in ectomycorrhizae.

In summary, amyloid reactions of hyphae seem to be at least not extraordinary in ectomycorrhizae and/or fruitbodies of members of the families Thelephoraceae ss. Stalpers, Bankeraceae ss. Stalpers, Scutigeraceae, Gomphidiaceae, Boletaceae, and Rhizopogonaceae. In other families of potential ectomycorrhiza formers amyloidity occurs either exceptionally, as in Tricholomataceae (culture of *Tricholoma imbricatum*: Miller 1971; after Treu (1990) with no amyloidity in ectomycorrhizae, the same is true for all ectomycorrhizae of this genus which have been studied so far: Agerer 1995b). Members of Russulaceae and some other relationships only have amyloid spores (Jülich 1981, Singer 1986, Smith & Zeller 1966). So far amyloid reactions are unknown in ectomycorrhizae of the Russulaceae genera *Lactarius* and *Russula* (Agerer 1995b). In addition, amyloid reactions of hyphae are documented only from a few saprophytic fungi. Miller (1971) reports about a 'bona fide' amyloidity in cultures of *Clitocybe illudens* (Schwein.) Sacc., likely a member of the genus *Omphalotus* (Singer 1986), which is now known as rather closely related to Boletaceae (Kämmerer et al. 1985). In *Panellus serotinus* a definite amyloid reaction was only found in the protoplast (Miller 1971). *Lentinellus* Karst. was reported as having amyloid hyphae in the fruitbodies (Miller 1971, Moser 1983). The latter is related to Russulaceae (Oberwinkler 1977a) as is *Hericium*, which is known to possess amyloid hyphae. Amyloid reaction also occurs in skeletal hyphae of *Antrodia*, and in cystidia of *Amylocystis* (Jülich 1984).

Co-occurrence of amyloidity and blue granules (in water), or at least of blue cell walls (in water), has been reported before (Agerer 1994, Harrison 1964, Stalpers 1993). Stalpers (1993) mentioned that the spores of *Tomentellago aeruginascens* become blue in bases and in Melzer's regent as well. Harrison (1964) described an additional amyloid reaction of already blue granules. In *A. ovinus* the blue granules (in water) became also darker blue in Melzer's reagent. In *Hydnellum* and *Sarcodon* typical amyloidity could also be found and was often associated with the occurrence of a colour change of hyphae to blue-green in KOH, this was called "apparent amyloidity" (Harrison 1964). The blue granules of *Hydnellum* and *Sarcodon* species dissolved in KOH and caused a blue-green reaction (Harrison 1964). The blue granules might contain thelephoric acid which is known to change colour in KOH (Gill & Steglich 1987, Hjortstam & Ryvarden 1988). Such a reaction was shown for blue hyphal walls (in water) of *Pseudotomentella tristis* (P. Karst.) M. J. Larsen ectomycorrhizae by Agerer (1994) and for some *Hydnellum* and *Sarcodon* fruitbodies by Harrison (1964). These findings fit well to our own results on ectomycorrhizae of *Albatrellus ovinus* (s. above) and for *Pseudotomentella tristis* (Agerer 1994) that blue granules can be associated with amyloid reactions of hyphal walls. However, no colour changes of blue granules occurred after treatment with KOH in *Albatrellus ovinus*. Larsen (1972) observed on fruitbody hyphae of *Pseudotomentella tristis* in KOH no colour change of blue granules to greenish.

In conclusion, to date blue granules (in water) could only be found in species where thelephoric acid has been found or can be assumed to occur due to their relationship (s. above). In several cases these granules turned to greenish after treatment with KOH which was assigned to the presence of thelephoric acid, in others they retained their original colour (s. above). Thelephoric acid has also been detected in Thelephoraceae species (Gill & Steglich 1987) which do not possess blue granules (Jülich 1984, Stalpers 1993). Therefore it can be hypothesized that, dependent of the species, thelephoric acid might occur in different concentrations in these blue granules. In *A. ovinus*, thelephoric acid therefore might be present in the blue granules of the stipe.

Some species of ectomycorrhizal fungi are known to form a part of their mycelium in ectomycorrhizae of other species. This is valid for all Gomphidiaceae species investigated to date and for *Boletopsis leucomelaena* (Agerer 1995b). Even fruitbodies can develop on rhizomorphs of ectomycorrhizae formed by another species. This could be shown for *Chroogomphus helveticus* ssp. *tatrensis* on *Rhizopogon cf. vulgaris* and for *Gomphidius glutinosus* on rhizomorphs of a *Rhizopogon* and a *Suillus* species (Agerer 1990, 1991a). Consequently, the question has to be addressed, if the fruitbodies of *Albatrellus ovinus*, too, could be formed on rhizomorphs of another, possibly a thelephoraceous ectomycorrhiza. Several reasons stand against this hypothesis. Firstly, the stipe base hyphae of *Albatrellus ovinus* are amyloid and between them blue granules are interspersed (Fig. 1e,f). Secondly, shape and amyloidity of the caulocystidia (Fig. 1e) correspond to some hyphal ends of the rhizomorphs (Fig. 1c) and of the mantle surface (Fig. 1d). Thirdly, all hyphae of the rhizomorphs were identically shaped, no foreign hyphae could be detected. Lastly, the stipe hyphae were all of the same type, no foreign hyphae could be found (Fig. 1f). Thus it seems very unlikely that the many rhizomorphs which are connected to the fruitbody base do belong to another fungus.

Some remarks on the systematic position of Scutigeraceae

A recent review (Agerer 1995b) showed that in some cases ectomycorrhizal features can emphasize or hint to fungal relationships. As an example it was possible, to prove special ectomycorrhizal characteristics for each of the families Tuberaceae, Gomphidiaceae, Boletaceae subf. Suilloideae, Boletaceae subf. Boletoideae incl. subf. Xerocomoideae, although other families are more heterogeneous with respect to their ectomycorrhizae. This situation is represented by the families Cortinariaceae, Russulaceae, Rhizopogonaceae, and Thelephoraceae s. l. For some relationships, e.g. the genus *Lactarius* it was forecast that ectomycorrhizal features might help to define subgeneric entities (Agerer 1995b).

It was already discussed in detail, that there are some similarities which hint to a closer relationship between Gomphidiaceae and Thelephoraceae (Agerer 1991a). In the present contribution the striking similarities of Thelephoraceae ectomycorrhizae with those of the Scutigeraceae *Albatrellus ovinus* require a more detailed comparison of both relationships including features of their fruitbodies.

The order Thelephorales (Oberwinkler 1977a, 1977b) or the family Thelephoraceae s. l. (incl. Bankeraceae) is essentially based upon anatomical characters (Donk 1964). The most important features are after Oberwinkler (1977a) 'for many of the species primarily tuberculate, and in addition warty-spiny, membranaceously pigmented spores'. But some deviations are well known. The genus *Scytinopogon* with almost colourless, warty or echinulate spores (Corner 1950) belongs after Donk (1964), but not after Stalpers (1993) to this relationship, too. Whether or not the inclusion of genus *Tylospora* with hyaline spores which are lobed, triangular in side view, smooth or warted, in the Thelephorales (Stalpers 1993) is justified has to be proven. Finely echinulate but colourless spores are known in several genera of Bankeraceae (Donk 1964, Stalpers 1993). The occurrence of thelephoric acid in all members studied so far (Bresinsky & Rennschmid 1971, Gill & Steglich 1987) has added an important chemical feature to the definition of this relationship. Consequently, two features remain to define the order Thelephorales. Those are the warty or lobate spores, although the ornamentation can be sometimes indistinct, and the occurrence of thelephoric acid. Another feature, which has to be studied in more detail is the amyloid reaction of parts of the fruitbody or/and of ectomycorrhizal hyphae. Amyloidity could be shown in all species of Thelephoraceae ss. Stalpers studied so far as well as in several members of the Bankeraceae (Harrison 1964); however, only a small number of species has been analysed to date (see above). *Thelephora terrestris*, however, the type species of the genus and family, shows amyloid hyphae (Agerer 1991a).

Is the occurrence of thelephoric acid important enough to define the Thelephorales in addition to the warty spores? Or does this compound occur in more remote relationships, too? Besides the above discussed occurrence in *Albatrellus*, a few other genera are known to produce thelephoric acid. After Gill & Steglich (1987) it occurs in at least one species of the genera *Punctularia* (Punctulariaceae), *Trametes* (Polyporaceae s. l.), *Lampteromyces, Omphalotus* (Omphalotaceae), *Paxillus* (Paxillaceae), *Rhizopogon* (Rhizopogonaceae), and *Suillus* (Boletaceae subf. Suilloideae).

The latter four families all belong to the order Boletales, where pulvinic acids could be found along with atromentin as a key intermediate for these compounds as well as for thelephoric acid (Gill & Steglich 1987). Atromentin itself could only be detected in members of Boletales, Thelephorales and in *Albatrellus cristatus* (Schff.: Fr.) Kotl. & Pouz. (Gill & Steglich 1987). The occurrence of thelephoric acid in the genus *Punctularia* (Punctulariaceae Donk 1964) is rather surprising. Due to its catahymenium, brownish acanthohyphidia, smooth spores, slightly gelatinous trama, absence of blue pigments and amyloidity, this family is rather distant from Thelephoraceae (comp. Donk 1964), although brownish, clamped subicular hyphae, and ellipsoid, yellowish, in old conditions brown spores are reminiscent of some Thelephoraceae (own observations). The occurrence of thelephoric acid in the genus *Trametes* is obviously erratic in a very distant relationship (Gill & Steglich 1987). Consequently, it is impossible to discern fungal relationships by the occurrence of thelephoric acid alone, but it seems, that, at least in combination with the above discussed features, a closer relationship between *Albatrellus ovinus* and some Thelephoraceae could be indicated.

Agerer (1991a) hypothesized in some detail that Thelephorales and Boletales may have common ancestors. The pro arguments included atromentin as a common compound and the formation of amyloid substances. Although this is in contrast to spore morphology, similarities were discussed between spores of Thelephoraceae and of the family Strobilomycetaceae (Boletales). The genus *Albatrellus*, viz. the family Scutigeraceae might also be included in this group, which forms the key intermediate atromentin, and/or thelephoric acid, and occasionally amyloid structures. Closer affinities to Thelephorales can be hypothesized.

The following arguments would support an inclusion of Scutigeraceae into the Thelephorales: (a) Amyloidity of hyphae. (b) Production of thelephoric acid and atromentin. (c) Ability to form ectomycorrhizae. And (d) very similar ectomycorrhizae. At least those of *Albatrellus ovinus* are similar to those of *Thelephora terrestris*.

Although other members of Thelephoraceae ss. Stalpers can form different ectomycorrhizae, even such with pseudoparenchymatous mantles occur, as realized in some *Tomentella*-species (Danielson et al. 1984), they can still form cystidia which are typical for *Thelephora terrestris* (Agerer et al. 1995, Danielson et al. 1984, Danielson & Pruden 1989). As also plectenchymatous mantles without cystidia can be formed in this family, Thelephoraceae ss. Stalpers are heterogeneous with respect to ectomycorrhizal features. This heterogeneity stresses that the anatomy of ectomycorrhizal mantles alone cannot provide the crucial characters for recognition of fungal relationships. But in combination e.g. with the occurrence of thelephoric acid and amyloidity relations can be indicated.

Would spore ornamentation per se prevent an inclusion of Scutigeraceae into the order Thelephorales? Smooth, wrinkled, striate, and even reticulate and warty spores are realized in the order Boletales, too (Pegler & Young 1981, Singer 1986). Pegler & Young (1981) even pointed out the importance of spore morphology for recognition of relationships within the Boletales. Spores of some *Albatrellus* spp. can be amyloid (Jülich 1984). Amyloid spores are unknown in most Thelephorales (Stalpers 1993), however *Tomentellago aeruginascens* Hjortstam & Ryvarden does form amyloid spores (Hjortstam & Ryvarden 1988). As at least in one member of Thelephoraceae amyloid spores are known, the amyloid spores of *Albatrellus* do not contradict a closer relationship between these two families.

The most modern, and presently highly appreciated method to study fungal relationships is the analysis of DNA (Bruns & Palmer 1989, Bruns et al. 1991). With DNA-comparison it should be possible to address and to answer the question if there are natural relations between Thelephoraceae and Bankeraceae on the one hand, and Scutigeraceae on the other. In fact there is some evidence of a closer relationship at least between *Sarcodon* and *Albatrellus* (Bruns, pers. comm.).

If an inclusion of Scutigeraceae into Thelephorales should be confirmed in the time to come, it would be an exciting case, where ectomycorrhizal characters would have been the crucial factor for elucidating fungal relationships.

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THE CHEMISTRY OF SOME SPECIES OF LECANORA SENSU STRICTO (LECANORALES, LICHENIZED ASCOMYCOTINA)

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Abstract: The chemistry of 27 species belonging to the *Lecanora subfusca* group (i.e. *Lecanora* s.str.) has been investigated, in most cases for the first time. 5-Chlorolichexanthone, isoplacodiolic acid, isonotatic acid, 6-*O*-methylarthothelin, 4-*O*-methylhypoprotocetraric acid, 2'-*O*-methylstenosporic acid and zeorinone are recorded for the first time in *Lecanora* s.str. *L. flavidocarnea* Vainio is reduced to synonymy with *L. helva* Stizenb. and *L. rubrofusca* B. de Lesd. with *L. puniceofusca* Bagl.

In the course of our continuing revision of taxa belonging to the lichen-forming genus *Lecanora* Ach., we have examined the chemistry of numerous type collections of species described from different parts of the world. In the first part of our taxonomic revision we described the Australasian taxa (Lumbsch 1994) and have now extended our investigation to the neotropical species. In this paper we report studies on type specimens not included in the revision of the Australasian taxa. In most cases the species were studied chemically for the first time. Other taxa are included where our chemical results complement those of earlier reports.

Material and Methods

Material. Type specimens were studied from the following herbaria: G, H, HIRO, KYO, MOD, PC, TUR, UPS, W and ZT.

Methods. Chemistry. The chemical constituents were identified using thin layer chromatography, TLC (Culberson 1972, Culberson et al. 1981, Culberson & Johnson 1982), gradient-elution high performance liquid chromatography, HPLC (Feige et al. 1993) and lichen mass spectrometry (Elix & Crook 1992).

Results and Discussion

1. Lecanora achrooides Vainio

Acta Soc. Fauna Flora Fenn. **7:** 79 (1890). - Type: Brazil, Minas Geraës, "ad corticem prope Sitio", 1000 m alt., 1885, *E. Vainio 5596 a* [=Vainio, Lich. Bras. exs. 912 b] (TUR-V 5123 - lectotype).

Major substances: atranorin and arthothelin; minor substances: chloroatranorin, thiophanic acid and usnic acid.

Morphologically this neotropical species resembles *L. leprosa* and *L. louisianae*, but differs from both species in its chemistry. Another similar species is *L. achroa*. However, the ascospores of *L. achrooides* are narrower and it has a slightly different chemistry (*L. achroa* contains ± arthothelin, atranorin, chloroatranorin, 2'-*O*-methylperlatolic acid, usnic acid and unidentified triterpenoids).

2. Lecanora addubitata Krempelh.

Flora **56:** 473 (1876). - Type: Chili, Valdivia, 1870/71, *R. Rabenhorst fil.* (UPS - lectotype).

Major substances: atranorin and unknown fatty acid; minor substances: chloroatranorin and unknown triterpenoids.

This saxicolous species is known only from South America. It is characterized by a whitish grey thallus with dark brown apothecial discs, a *campestris* type epihymenium, a *glabrata* type amphithecium and the chemistry.

3. Lecanora bogotana Nyl.

Ann. Sci. Nat. Bot. ser. 5, **7:** 311 (1867). - Type: Colombia, "Nova Granata", Bogota, 2600 m alt., on bark, 1860, *Lindig 737* (H-NYL p.m. 3005 - lectotype; H-NYL 27868 - isolectotype).

Major substances: atranorin, pannarin and zeorin; minor substances: chloroatranorin and usnic acid.

4. Lecanora byssulina Zahlbr.
in Handel-Mazzetti, Symbol. Sinic. **3:** 165 (1930). - Type: China, "Setschwan, Phyllitfelsen der Str. St. bei Schangliangdse nächst Dötschang im Djentschang ("Kientschang")", 1770 m alt., on rock, 5.4.1914, *H. Fr.v. Handel-Mazzetti 1806* (W - holotype).

Major substances: atranorin and 2'-*O*-methylperlatolic acid; minor substances: chloroatranorin, 2'-*O*-methylstenosporic acid and usnic acid.

Lecanora byssulina resembles *L. plumosa* Müll. Arg. a species which was originally described from Australia, but subsequently recorded from South Africa and North America (Lumbsch & Feige 1994; Lumbsch & Nash 1995). A formal decision of the status of *L. byssulina* must be postponed until more material from China becomes available, but it is possible that this species may be conspecific with *L. plumosa*.

5. Lecanora caesiorugosa B. de Lesd.
Lichens du Mexique: 13 (1914). - Type: Mexico, Puebla, Ha. St. Barbara, 2150 m alt., on bark, 5.9.1907, *G. Arsène 4142* (UPS - lectotype).

Major substances: atranorin and zeorin; minor substances: chloroatranorin and unknown triterpenoids.

This species is morphologically similar to *L. flavidomarginata* B. de Lesd., but the latter species can be distinguished by the presence of usnic acid, and various anatomical characters (e.g. spore size).

6. Lecanora carneolutescens Nyl.
Flora **61:** 380 (1858). - Type: Mexico, Orizaba, on bark, *Fr. Müller* (H-NYL 27911 - holotype).

Major substances: atranorin and zeorin; minor substances: chloroatranorin and unknown triterpenoids.

7. Lecanora dissoluta Nyl.
Flora **49:** 131 (1866). - Type: "Java, circa Toegoe", 3000 ft. alt., on bark, *Kurz* (H-NYL 27883 - holotype).

Major substances: atranorin, zeorin and zeorinone; minor substances: an orange pigment and two unknown terpenes.

8. Lecanora emergens Müll. Arg.
J. Linn. Soc. London, Bot. **29:** 220 (1892). - Type: India, Manipur, on bark, *G. Watt 40* (G - holotype).

Major substances: atranorin and zeorin; minor substances: chloroatranorin, zeorinone and an unknown fatty acid.

9. Lecanora epirhoda Vainio
Acta Soc. Fauna Flora Fenn. **7:** 76 (1890). - Type: Brazil, Minas Geraës, "ad corticem arborum prope Sitio, 1000 m", 1885, *E. Vainio 6084 a* [=Vainio, Lich. Bras. exs. 1009] (TUR-V-5353 - holotype).

Major substances: atranorin and 2'-*O* -methylperlatolic acid; minor substance: chloroatranorin.

10. Lecanora flavidocarnea Vainio
Hedwigia **37:** (41) (1898). - Type: "Africa cantralis, Kikuyu, ad corticem arboris, 6-8000 ft., 1893/94, *G.F. Scott Elliot* (TUR-V 5581-holotype).

Major substances: atranorin and 2'-*O*-methylperlatolic acid; minor substances: chloroatranorin and unknown substances.

The type specimen of *L. flavidocarnea* is extremely small and in poor condition, but the morphology, anatomy and chemistry indicates that *L. flavidocarnea* is a synonym of *L. helva* Stizenb.

11. Lecanora fuscococcinea Nyl.
Ann. Sci. Nat. Bot. ser. 4, **11:** 257 (1859). - Type: "Insula Borboniem", on bark, *Lepermanche-Mézieres 78* (H-NYL 27909 - holotype).

Major substances: atranorin, two unknowns and zeorin; minor substance: chloroatranorin.

12. Lecanora gongensiana Miyawaki
J. Hattori Bot. Lab. **64:** 301 (1988). - Type: Japan, Kyushu, Pref. Nagasaki, Nishisonogi-gun, Insel Takashima, Mt. Gongen, 115 m alt., on rock, 5.5.1983, *H. Miyawaki 6556* (HIRO - holotype).

Major substance: 2'-*O*-methylperlatolic acid; minor substances: atranorin, chloroatranorin and an unknown fatty acid.

When describing this species Miyawaki (1988) recorded the presence of atranorin, the unidentified "Lecanora-3" and further unidentified compounds. *L. chrysocardia* Zahlbr. is similar, but lacks 2'-*O*-methylperlatolic acid.

13. Lecanora iseana Räsänen
J. Jap. Bot. **16:** 91 (1940). - Type: Japan, Prov. Ise, Mt. Gozaisho, on bark, 8.1913, *A. Yasuda 664* (H - lectotype, H - isolectotype).

Major substances: 2'-*O*-methylperlatolic acid; minor substances: atranorin, chloroatranorin, 2'-*O*-methylstenosporic acid, usnic acid and unknown constituents.

Miyawaki (1988) previously reported atranorin, zeorin and the unidentified substance "Lecanora-3" from this Japanese species.

14. Lecanora labiosa Stizenb.
Ber. Thätigk. St. Gall. naturw. Ges.: 215 (1890). - Type: Südafrika, Transvaal, am Spitzkop bei Lydenburg, on bark, Wilms (ZT - holotype).

Major substances: atranorin and 2'-*O*-methylperlatolic acid; minor substance: chloroatranorin.

15. Lecanora louisianae B. de Lesd.
Bull. Soc. Bot. Fr. **78:** 727 (1932). - Type: USA, Louisiana, Covington, on bark, 1921-23, *F.A. Brouard* (PC, UPS - syntypes); Covington, Madeville, Lac Ponchartrain, 1921-23, *F.A. Brouard* (UPS - syntype); Lafayette, 4.1930, *F. Néon* (UPS - syntype).

Major substances: arthothelin, atranorin and thiophanic acid; minor substances: chloroatranorin and 2,4-dichloronorlichexanthone.

The chemistry of *L. louisianae* was examined previously by Brodo (1984) who detected atranorin and the unidentified xanthones Lls-1 and Lls-2.

16. Lecanora microphaea Zahlbr.
in Handel-Mazzetti, Symbol. Sinic. **3:** 166 (1930). - Type: China, "Prov. Kweitschou, an lebenden Ästen von *Schizophragma integrifolium* und *Xylosma racemosus*, auf dem Nanyo-schan bei Kweiyang, 1250-1300 m", 4.7.1917, *H.F. v. Handel-Mazzetti 10544* (W-6090 - holotype).

Major substance: atranorin; minor substances: chloroatranorin and planaic acid.

In the genus *Lecanora*, planaic acid has only been recorded previously from the saxicolous *L. planaica* Lumbsch (Elix et al. 1994; Lumbsch 1994).

17. Lecanora mikuraensis Miyawaki
J. Hattori Bot. Lab. **64:** 295 (1988). - Type: Japan, Izu Islands, Hachijo, Mt. Hachijofuji, 650 m", on bark, 21.7.1981, *M. Higuchi 10645* (HIRO - holotype).

Major substances: arthothelin and 2'-*O*-methylperlatolic acid; minor substances: 6-*O*-methylarthothelin, atranorin, chloroatranorin, 2,7-dichloronorlichexanthone and 4,5-dichloronorlichexanthone.

Previously Miyawaki (1988) recorded atranorin and unidentified minor constituents from *L. mikuraensis*.

18. Lecanora nipponica Miyawaki

J. Hattori Bot. Lab. **64:** 296 (1988). - Type: Japan, Honshu, Pref. Tottori, Tatsumi Paß, 780 m alt., on bark, 29.7.1982, *H. Miyawaki 6283* (HIRO - holotype).

Major substance: placodiolic acid; minor substances: atranorin, chloroatranorin and isoplacodiolic acid.

Atranorin, the unidentified substance "Lecanora-2", and further unidentified minor constituents were recorded by Miyawaki (1988) when he described this species from Japan.

19. Lecanora perithoides Nyl.

Flora **59:** 508 (1876). - Type: Cuba, on rocks, *C. Wright 66* (H-NYL 27296 - lectotype, hiermit ausgewählt).

Major substances: atranorin and 5-chlorolichexanthone; minor substances: chloroatranorin, 5,7-dichloro-3-*O*-methylnorlichexanthone and unknowns.

The presence of a chlorinated lichexanthone as a major secondary metabolite in a member of the *L. subfusca* group is unprecedented. Hitherto chlorinated lichexanthones were only observed as minor or trace components in chemosyndromes dominated by chlorinated norlichexanthones (Lumbsch et al. 1994).

20. Lecanora puniceofusca Bagl.

Nuov. Giorn. Bot. Ital. **11:** 73 (1979). - Type: Italy, Sardinia, "Abbundante sulle rocce a S. Barbara sopra Capoterra", on rocks, 17.3.1864, *Baglietto* (MOD - holotype).

=*Lecanora rubrofusca* B. de Lesd., Bull. Soc. Bot. Fr. **78:** 726 (1932). - Type: Italy, "Liguria occidentalis, Pselo (Spotorno)", 1930, *C. Sbarbaro* (UPS - neotype).

Major substances: atranorin and 2'-*O*-methylperlatolic acid; minor substance: chloroatranorin.

The chemistry of this species was recorded previously by Brodo & Elix (1993) and their results are confirmed here. Recently type material of *L. puniceofusca* became available for study, and we confirmed our former assumption

(Lumbsch 1994) that *L. rubrofusca* is a synonym of *L. puniceofusca* rather than of *L. pseudistera* Nyl. as proposed by Nimis (1993). *L. puniceofusca* is characterized by the *campestris*-type amphithecium, the presence of 2'-*O*-methylperlatolic acid, the small ascospores and the relatively dark grey colour of the thallus. It resembles *L. pseudistera*, but can be readily distinguished by the small crystals in the amphithecium. *L. puniceofusca* might also be confused with *L. campestris,* but the latter differs in chemistry (containing atranorin, chloroatranorin and unidentified triterpenoids) and has larger spores.

21. Lecanora rufocarnea (Vainio) Dodge

Beih. Nova Hedwigia **38:** 26 (1971). - *Lecanora cinereocarnea* var. *rufocarnea* Vainio, Cat. Welw. Afr. Pl. **2:** 403 (1901). - Type: Angola, Golungo Alto, "ad truncos vigentes Anacardiacearum (Spondias) in sylvis inter Sange et Trombeta", *C. Welwitsch 129* (TUR-V 6083 - holotype).

Major substance: atranorin; minor substances: chloroatranorin and unknown fatty acid.

22. Lecanora subcrenulata Müll. Arg.

Flora **71:** 533 (1888). - *Lecanora subfusca* var. *subcrenulata* (Müll. Arg.) Vainio, Anal. Acad. Sci. Fenn. ser. A, **6** (7): 30 (1915). - Type: Brazil, Morro de Itambé, on rocks, *Puiggari 2220* (G - holotype).

Major substance: isonotatic acid; minor substances: atranorin, chloroatranorin, 4-*O*-methylhypoprotocetraric acid and usnic acid.

Morphologically this species is similar to the Australasian *L. formosula* Lumbsch (Lumbsch et al. 1995) which, however, differs in containing only atranorin, usnic acid and unidentified fatty acids.

23. Lecanora subflava Tuck.

in Nyl., Flora **59:** 509 (1876). - Type: Cuba, on bark, *C. Wright 53* (H-NYL 27288 - holotype).

Major substance: arthothelin; minor substances: 6-*O*-methylarthothelin, atranorin, chloroatranorin and 2,4-dichloronorlichexanthone.

Previously Santesson (1969) reported arthothelin from this species.

24. Lecanora subtjibodasensis Zahlbr.

Ann. Crypt. Exot. **1:** 196 (1928). - Type: Indonesia, Java, Tjibodas, on *Altingia excelsa*, 9.9.1920, *W. Seifrieg 64* (W-1679 - holotype).

Major substance: atranorin and thiophanic acid; minor substances: arthothelin, chloroatranorin and 2,7-dichloronorlichexanthone, 4,5-dichloronorlichexanthone and 4,7-dichloronorlichexanthone.

25. Lecanora sulcata (Hue) Miyawaki

J. Hattori Bot. Lab. **64:** 307 (1988). - *Lecanora subrubra* var. *sulcata* Hue, Ann. Mycol. **13:** 96 (1915). - Type: Japan, Hokkaido, Rishiri Island, on bark, 25.7.1899, *U. Faurie 1389* (KYO - isotype).

Major substance: placodiolic acid; minor substances: atranorin, chloroatranorin and isoplacodiolic acid.

Miyawaki (1988) previously reported atranorin and unidentified minor compounds in this species.

26. Lecanora tjibodasensis Zahlbr.

Ann. Crypt. Exot. **1:** 195 (1928). - Type: Indonesia, Java, Tjibodas, on bark, 9.9.1920, *W. Seifrieg 66 B* (W-1688 - holotype).

Major substances: arthothelin, atranorin and thiophanic acid; minor substances: chloroatranorin and 2,7-dichloronorlichexanthone, 4,5-dichloronorlichexanthone and 4,7-dichloronorlichexanthone.

27. Lecanora toroyensis Zahlbr.

Feddes Rep. **33:** 52 (1933). - Type: Taiwan, Toroyen, Arisan, 24.12.1925, *Y. Asahina F 144* (W-696 - holotype).

Major substance: 2'-*O*-methylperlatolic acid; minor substances: atranorin, chloroatranorin and 2'-*O*-methylstenosporic acid.

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MYCOTAXON

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ALTERNARIA THEMES AND VARIATIONS (150)

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ABSTRACT

An index to fungus names that appear in the series *Alternaria Themes and Variations* nos. 1-149 (*Mycotaxon* vol. 13-57) is followed by an index to hosts/substrates noted in the same papers. An *Addendum* lists names for *Alternaria* taxa and related synonyms that have been treated by Simmons in publications other than *Mycotaxon*.

Introduction

There currently are approximately 500 *Alternaria* epithets that have been proposed since 1816 at various levels of taxonomic rank (mostly as species) and that have various claims to nomenclatural (ICBN) legitimacy. An additional 400+ *Macrosporium* epithets and related specimens must be considered in any comprehensive taxonomic treatment of *Alternaria*, as must 100-200 other names originally published in a miscellany of genera such as *Helminthosporium* and *Sporidesmium*.

Approximately 300 of these 1000+ names were considered in some way in the recently published *Alternaria Chronology and Catalogue Raisonné. Part I 1796-1871* (Simmons, E. G., Mycotaxon 55: 1-53. 1995.), and were indexed completely with that paper. About 250 names applied at one time or another to taxa discussed in *Alternaria Themes and Variations* nos. 1-149 are indexed below. Many names are duplicated between the two series of publications, in that current notes in the *Alt.T&V* series refer as needed to names of the 1796-1871 period.

The following index is to fungus names and to hosts/ substrates that are cited in the *Alt.T&V* series of taxonomic notes, all of which were published in *Mycotaxon*. Each index entry is followed by pertinent *Mycotaxon* volume and page numbers, e.g., 13: 16. Genus name references in the index are abbreviated only for *Alternaria* (Alt.), *Macrosporium* (Macr.), *Stemphylium* (St.), and *Ulocladium* (Ulo.). Publication data for the entire *Alt.T&V* series to date follow on this page. The author of each paper is E. G. Simmons, except when noted otherwise.

Alternaria Themes and Variations:

Nos.	[1-6].	Mycotaxon	13: 16-34.	1981.
	(7-10).		14: 17-43.	1982.
	(11-13).		14: 44-57.	1982.
	(14-16).		25: 195-202.	1986.
	(17-21).		25: 203-216.	1986.
	(22-26).		25: 287-308.	1986.
	(27-53).		37: 79-119.	1990.
	(54-62).		46: 171-199.	1993.
	(63-72).		48: 91-107.	1993.
	(73).		48: 109-140. (with R. G. Roberts)	1993.
	(74-105).		50: 219-270.	1994.
	(106-111).		50: 409-427.	1994.
	(112-144).		55: 55-163.	1995.
	(145-149).		57: 391-409.	1996.

An *Addendum* to this *Alt.T&V* Index lists *Alternaria* names and related synonyms that have appeared in Simmons publications other than the *Chronology* and *Alt.T&V* series noted above. Literature citations for the appended list precede the *Addendum: Index of Fungus Names* and the *Addendum: Index of Hosts*. There also, E. G. Simmons is the author of each paper cited, except when noted otherwise.

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Addendum: INDEX OF HOSTS

Only three *Alternaria* taxa were discussed with specific host reference in the addendum literature.

Chrysanthemum maximum: *A. chrysanthemi* **1965**

Cyamopsis tetragonoloba: *A. cucumerina v. cyamopsidis* **1966**

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- triticina **1978**: 133; **1992**: 23
- zinniae **1992**: 22, 24

Embellisia **1990**: 260
- dennisii **1990**: 257
- eureka **1990**: 260
- phragmospora **1983**: 232

Helminthosporium
- cheiranthi **1964**: 46

Macrosporium **1964**: 46
- cheiranthi **1964**: 46
- consortiale **1967**: 84
- heteroschemon **1989**: 323
- septosporum **1967**: 87

Nimbya
- gomphrenae **1989**: 324
- heteroschemos **1989**: 323
- scirpicola **1989**: 318

Sporidesmium
- scirpicola **1989**: 318

Stemphylium **1967**: 67, 75

Ulocladium **1967**: 67, 75
- chartarum **1967**: 88
- consortiale **1967**: 84
- lanuginosum **1967**: 67, 75
- septosporum **1967**: 87

MYCOTAXON

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SOME NEW SPECIES AND NEW RECORDS OF DISCOMYCETES IN CHINA. VI

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ABSTRACT A new taxon, *Lanzia glandicola* var. *cornicola,* is described. Nine taxa are reported for the first time from China based mainly on collections from the Qinling Mountains in Shaanxi and Gansu provinces.

NEW TAXON

1. Lanzia glandicola (K.S.Thind & H.Singh) Dumont var. **cornicola** W.Y.Zhuang, **var. nov.** (Fig. 1a)

Ab Lanzia glandicola cellulis excipularibus ectalibus parvulis, excipulis medullaribus incrassatulis, subhymeniis nullis, stipitibus ad basim non adustis, apotheciis in Cornis differt.

Apothecia discoid, stipitate, 1.7-2.3 mm in diam, hymenium orange to peachy-orange, receptacle concolorous with hymenium, stipe length varying with position of seeds buried in soil; ectal excipulum outer layer of textura prismatica, inner layer of long-celled hyphae, 66-75 μ m thick, cells hyaline, 10-20 x 4-9 μ m, stipe surface with short, cylindrical hyphal protrusions; medullary excipulum of textura intricata, 37-47 μ m thick, hyphae hyaline; asci clavate, 8-spored, J+, pore walls blue in Melzer's reagent, 67-72 x 5.5-6.5 μ m; ascospores uniseriate, ellipsoid to subfusoid, one end slightly wider, hyaline, unicellular, nonguttulate, 7.0-8.0(-9.0) x 2.9-3.2 μ m; paraphyses filiform, 1.3-1.5 μ m wide.

Holotype: on fruits of *Cornus controversa* buried in soil, Qingchengshan, Sichuan, R.Y.Zheng & R.P.Korf, 17.IX.1981, CUP-CH 2356.

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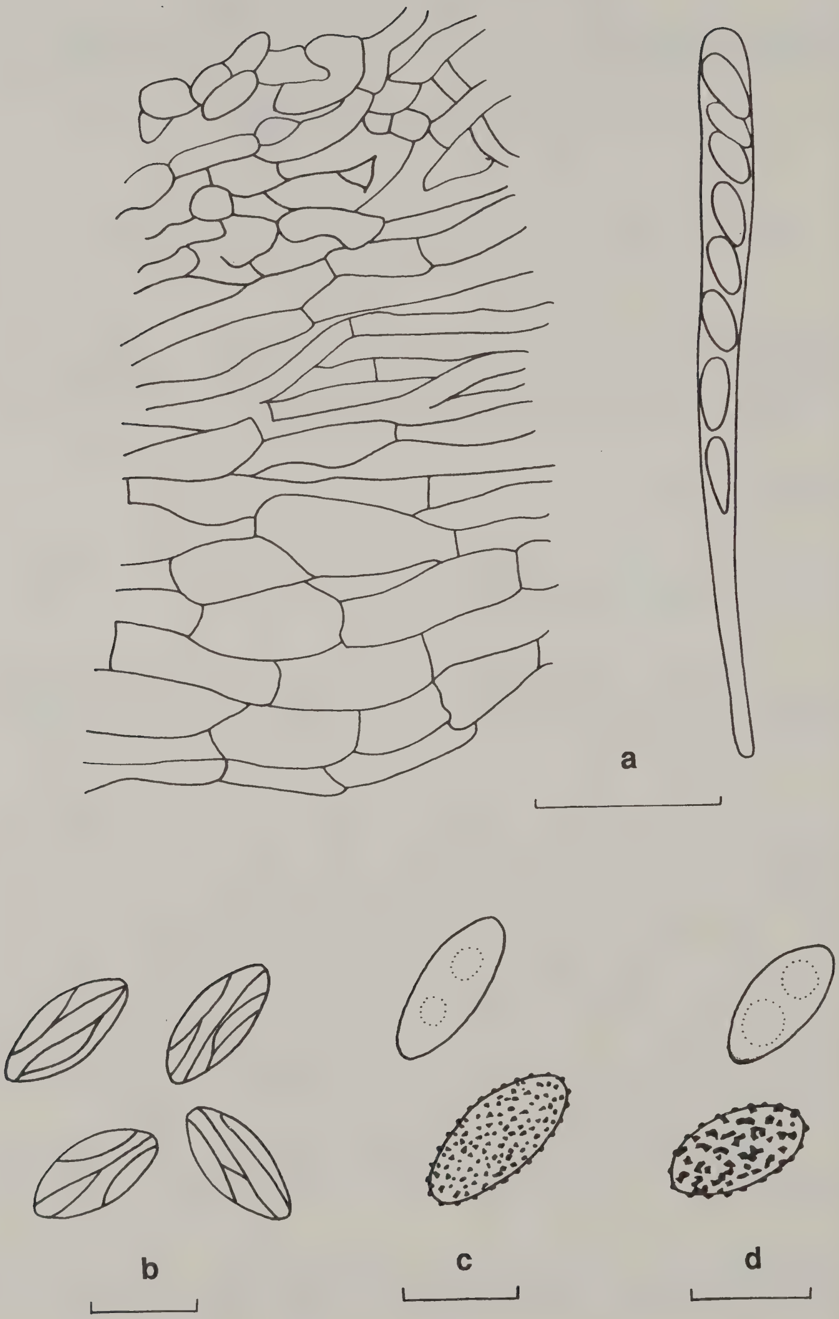
a
b
c
d

Paratypes: on fruits of *Cornus controversa* buried in soil, Qingchengshan, Sichuan, R.Y.Zheng & R.P.Korf, 16.IX.1981, CUP-CH 2325; on fruits of *Cornus controversa* buried in soil, Qingchengshan, Sichuan, R.Y.Zheng & R.P.Korf, 18.IX.1981, CUP-CH 2380; on pits of ?*Cornus controversa,* Fujimi-mura, Mt. Okagi, Gumma Pref., Honshu, Japan, IMC3 workshop people, 24.VIII.1983, CUP-JA 3672.

Notes: The apothecial structure of this fungus indicates that it is a species of *Lanzia* Sacc. In the genus the closest species is *Lanzia glandicola* (K.S.Thind, & H.Singh) Dumont which is from India and found only on fruits of *Quercus* sp. (Thind & Singh, 1972; Dumont, 1976). It is similar to *Lanzia glandicola* in excipular structure and the sizes of asci and ascospores but different from the latter in smaller excipular cells, subhymenium not clearly distinguished, thinner medullary excipulum (37-47 μ m vs. 130 μ m), stipe not blackened at base, and growing on *Cornus* sp. instead of on *Quercus* sp. To avoid a narrow species concept, the above distinctions are treated at varietal level as *Lanzia glandicola* var. *cornicola.*

NEW RECORDS FOR CHINA

2. Ascobolus cervinus Berk. & Broome, J. Linn. Soc. Lond. (Bot.) 15: 85, 1876. (Fig. 1b)

Diagnostic features: apothecia discoid to turbinate, up to 0.9 mm in diam when rehydrated, hymenium dirty yellow when dry; ectal excipulum of textura angularis, 38-50 μ m thick; medullary excipulum of textura intricata, 40-85 μ m thick; asci J- in Melzer's reagent; ascospores ellipsoid to subfusoid, hyaline, with more or less parallel-arranged striations on surface, 13-17 x 6.6-7.8 μ m.

Specimen examined: on dung, Taibai Mountain, Shaanxi, Q.M.Ma et al. 2485, 19.VII.1963, HMAS 33705.

Notes: Compared with typical material (Brummelen, 1967), the asci of this collection do not protrude from the hymenial surface and ascospores are hyaline and with longitudinal striations.

HMAS 33705 was formerly misidentified as and filed under *Ascobolus aerugineus* Fr. in the herbarium. According to Brummelen (1967) *Ascobolus aerugineus* is a synonym of *Ascobolus furfuraceus* Pers. The morphology of HMAS 33705 is different from this species.

Fig. 1. **a.** *Lanzia glandicola* var. *cornicola:* Excipular structure and an ascus with ascospores, scale = 20 μ m, from holotype; **b-d.** Ascospores: **b.** *Ascobolus cervinus,* scale = 10 μ m, from HMAS 33705; **c.** *Peziza emileia,* scale = 15 μ m, from HMAS 27730; **d.** *Peziza* near *succosa,* scale = 15 μ m, from HMAS 30807.

3. Cheilymenia ciliata (Bull.) Maas Geest., Proc. Kon. Ned. Akad. Wetens.- Amsterdam, ser. C, 72: 313, 1969.

Specimen examined: on cow dung, Songpan, Gansu, alt. 3050 m, W.Y.Zhuang 1036, 16.IX.1992, HMAS 69604.

4. Coprobia striata (K.S. Thind, E.K. Cash & P. Singh) Waraitch, Trans. Brit. Mycol. Soc. 68: 303, 1977.

Specimen examined: on cow dung, Mianxian, Shaanxi, alt. 700 m, W.Y.Zhuang 914, 30.IX.1991, HMAS 69609.

Notes: The ectal excipular cells (up to 50 μ m in diam) are larger than the Indian materials (Thind & Kaushal, 1978).

5. Dumontinia tuberosa (Bull. : Fr.) Kohn, Mycotaxon 9: 433, 1979.

Diagnostic features: Sclerotia spherical, 5-9 mm in diam when dry, with a black cortex and white medulla; apothecia arising from spherical sclerotia, cupulate when fresh and funnel-shaped when dry, stipitate, 6.5-8.0 mm in diam when dry, hymenium dark brown when dry, receptacle lighter than hymenium, stipe brown and up to 60 mm long when dry; ectal excipulum of textura porrecta to textura oblita, 35-50-70 μ m thick, cell walls somewhat thickened and light brown; medullary excipulum of textura intricata, 127-200 μ m thick, hyphae more or less parallel to the outer surface, walls slightly brownish to subhyaline; subhymenium of densely textura intricata, 20-30 μ m or more thick; hymenium 126-136 μ m thick; asci cylindrical-clavate, 8-spored, J+, pore walls blue in Melzer's reagent, 120-137 x 8-10 μ m; ascospores ellipsoid to elongate-ellipsoid, uniseriate, hyaline, nonguttulate, 9.0-16.0(-19.0) x 5.7-7.0(-8.5) μ m; paraphyses filiform, 2.0-2.5 μ m wide.

Specimen examined: on grassy ground, host unknown, Dailing, Heilongjiang, Q.B. Chen, 15.V.1956, HMAS 27719.

Notes: The fungus was misidentified as *Monilinia oxycocci* (Woron.) Honey because the spherical sclerotia were mistakenly taken to be the fruits of *Vaccinium* sp. (Teng, 1963). Since the sclerotial medulla of this fungus consists only of hyphae without any plant tissues, it should be either a member of the genus *Sclerotinia* Fuckel or a taxon in *Dumontinia* Kohn. HMAS 27719 is distinguished from the former genus in the ectal excipulum of textura porrecta to textura oblita and fits well the concept of the latter genus (Kohn, 1979) as well as morphology of the only known species in that genus, *Dumontinia tuberosa* (Bull. : Fr.) Kohn.

6. Helvella sp. near **Helvella leucopus** Pers., Mycol. Eur. 1: 213, 1822.

Diagnostic features: pileus saddle-shaped, dark grayish brown, up to 38 x 38 mm, receptacle naked; stipe dirty white, surface smooth but pubescent under the dissecting microscope, up to 84 mm long; outer ectal excipulum of textura angularis, 110-130 μ m thick, cells ellipsoid, axes of cells perpendicular to the receptacle surface; inner ectal excipulum of textura angularis, 100 μ m thick, cells isodiametric; medullary excipulum of textura intricata, 120-150 μ m thick; subhymenium ca 50 μ m thick; hymenium 320-350 μ m thick; ascospores broadly ellipsoid, surface smooth, with fine warts or larger warts, 24-28 x 14-17 μ m.

Specimen examined: on the ground in forest, Luba, Shaanxi, alt. 950 m, W.Y.Zhuang 859, 21.IX.1991, HMAS 69596.

Notes: Although the gross morphology of the Luba collection is similar to that of *Helvella leucopus,* the stipes (compressed when dry, 5 x 2 mm in transverse section) are not as robust as in typical material and the ascospores are larger than typical (24-28 x 14-17 μ m vs. 21-24 x 13-15 μ m) (Dissing, 1966). It might represent an undescribed taxon but further investigation and observations are needed to make a final decision.

7. Peziza emileia Cooke, Mycographia fig. 379, 1879. (Fig. 1c)

Specimen examined: on the ground, Tianshui, Gansu, Y.C.Yang 588, 21.VIII.1958, HMAS 27730.

Notes: Ascospores of this collection are subfusoid, mostly uniseriate, biguttulate, with separate warts on the surface, and 19-20.5 x 8.8-10.5 μ m. Spore markings are 0.4-0.9 μ m in diam, up to 0.5 μ m high, and with larger ones at the ends.

8. Peziza near **succosa** Berk., Ann. Mag. Nat. Hist. 6: 358, 1841. (Fig. 1d)

Diagnostic features: apothecia deeply cupulate, 2.5 cm in diam; hymenium yellowish, 310-330 μ m thick; asci J+ in Melzer's reagent, 13-18 μ m wide; ascospores with warts on surface, 17-19 x 10-11 μ m, some of the markings interconnected, 0.3-0.8 μ m in diam; paraphyses 4-5 μ m wide.

Specimen examined: on the ground in forest, Taibai Mountain, Shaanxi, J.H.Yu 57, 23.6.1958, HMAS 30807.

Notes: The spore markings of this collection are not as large as in typical material (Hohmeyer, 1986).

9. Pulvinula constellario (Berk. & Broome) Boud., Hist. Class. Discom. Europe p.70, 1907.

Specimens examined: on soil, Tewo, Gansu, alt. 2600 m, X.Q.Zhang & W.Y.Zhuang 1008, 1009, 9.X.1992, HMAS 69610, 69611.

Notes: The Tewo collections possess larger apothecia (2-11 mm diam), smaller ascospores (12.7-15 μ m diam), and finer paraphyses (1.5 μ m wide) than is typical (Dennis, 1978).

10. Trichoglossum octopartitum Mains, Amer. J. Bot. 27: 325, 1940.

Specimen examined: on soil, Luba, Shaanxi, W.Y.Zhuang 841, 21.IX.1991, HMAS 69615.

Notes: The Luba collection has wider asci (180-216 x 19-25 μ m) and shorter and wider ascospores [(79-)83-124(-127) x 5.0-6.0 μ m] than North American material (Mains, 1954).

ACKNOWLEDGEMENTS

The author would like to express her deep thanks to Prof. R.P. Korf, Cornell University, USA and Dr. T. Schumacher, University of Oslo, Norway for consultations, to P. Lizon and S.C.Gruff of Cornell University for providing specimen information, to Dr. J.Y. Zhuang of this institute for correcting the Latin diagnosis, to Ms. X.F. Zhu of this institute for inking the drawings and Mr. S.X. Sun for editorial assistance. Prof. Korf is kindly serving as the pre-submission reviewer and making valuable suggestions. The project is partially supported by the Special Foundation for Floral Studies, Academia Sinica.

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MYCOTAXON

Volume LIX, pp. 343-348 July-September 1996

AN EXTREME MODIFICATION OF *MONOCILLIUM*: *MONOCILLIUM CURVISETOSUM* n. sp.

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An unusual *Monocillium*-like fungus was isolated from an aphid in Turkey and fibre pulp in Finland. While *Monocillium* species generally have phialides that are thick-walled in the lower part and have a certain tendency to remain sterile, in the new species, described as *Monocillium curvisetosum*, the thick-walled structures form curved setae, while sporulation occurs on thin-walled phialides with a swollen venter; but intermediate structures occur.

The finding of an unusual species, which can be regarded as an extreme modification of *Monocillium*, prompted this publication in anticipation of a broader revision of the genus. As far as it is known, the hyphomycete genus *Monocillium* S. B. Saksena comprises anamorphs of *Niesslia* Auersw. and thus forms a natural taxon. The genus was characterized by Gams (1971) as being similar to *Acremonium* Link : Fr., but always having unbranched conidiophores that consist of phialides with more or less conspicuously thickened walls in the lower part; above this region they are often somewhat inflated (sometimes ending with a sterile vesicle), but normally end in a slender, thin-walled portion; they produce hyaline, smooth-walled conidia from a terminal phialidic opening. Gams (l.c.) described 12 taxa, one more species has been published since as *Torulomyces*

(Matsushima, 1987), and several more await revision. The merging of *Monocillium* with *Torulomyces* (Hashmi *et al.*, 1972) is unacceptable, because the type species, *Torulomyces lagena* Delitsch, with its dry and persistent conidial chains is the anamorph of *Eupenicillium limoneum* Gochenaur & Zlattner and not at all related with *Niesslia*; it is regarded by some authors as congeneric with *Penicillium* (Stolk & Samson, 1983).

Monocillium curvisetosum W. Gams & Turhan, *sp. nov.* –Figs 1, 2.

Coloniae fere lente crescentes, dilute bubalinae, superficie modice granulata. Setae steriles, 0.5–1.5 μm crassitunicatae, hyalinae, sursum curvatae, copiosae, 100–300 μm longae, prope basim 2–3 μm, superne 3–4 μm latae; phialides ex hyphis aeriis vel fere submersis oriundae, erectae, in medio inflatae, plerumque tenuitunicatae, 7–13 × 2.5—3 μm (in parte media). Conidia capitulis parvis fere siccis aggregata, globosa, hyalina, fere crassitunicata, (3.5–)4.0–4.5 μm diam., raro ellipsoidea, 3.5–6 × 1.5–2.0 μm. Holotypus CBS 660.94, isolatus ex aphide quadam prope Smyrnam (Izmir) in Turkia, Feb. 1994, exsiccatus et vivus praeservatus.

Colonies on MEA, OA or CMA (media as described in Gams *et al.*, 1987) reaching 18–20 mm diam in 6 days at 21, and 21–28 mm at 24–30°C, pale buff, but on PDA sometimes turning brick–vinaceous (Rayner, 1970) under light; surface finely granular. Sterile curved setae abundantly produced and interspersed with superficial or aerial hyphae bearing numerous phialides; setae hyaline, smooth- and thick-walled (0.5–1.5 μm), 100–300(–330) μm long, 2–3 μm wide near the base, then mostly widening to 3–4 μm, and remaining so until the thin-walled, rounded tip; basal septum usually absent. Phialides erect, beginning with a more or less short slender stipe, inflated into a venter and tapering again into a conidiiferous tip, usually thin-walled throughout, but sometimes with an up to 0.3 μm thick-walled, more or less short stipe, usually 7–13 × 2.5–3 μm (width in middle part); stipe of the thin-walled phialides showing considerable variation in length, the longer ones often being considerably thick-walled. Conidia aggregated in small, more or less dry heads, globose, hyaline, rather thick-walled (0.5 μm), (3.5–)4.0–4.5 μm diam. Ellipsoidal conidia produced on poor media (PCA, SEA),

3.5–6 × 1.5–2.0 μm, in roughly equal numbers to the globose ones. Teleomorph unknown.
A broad optimum temperature for growth is observed from 24 to 30°C, at 36°C growth is still possible but reduced. Light only slightly affects colony pigmentation but not sporulation.

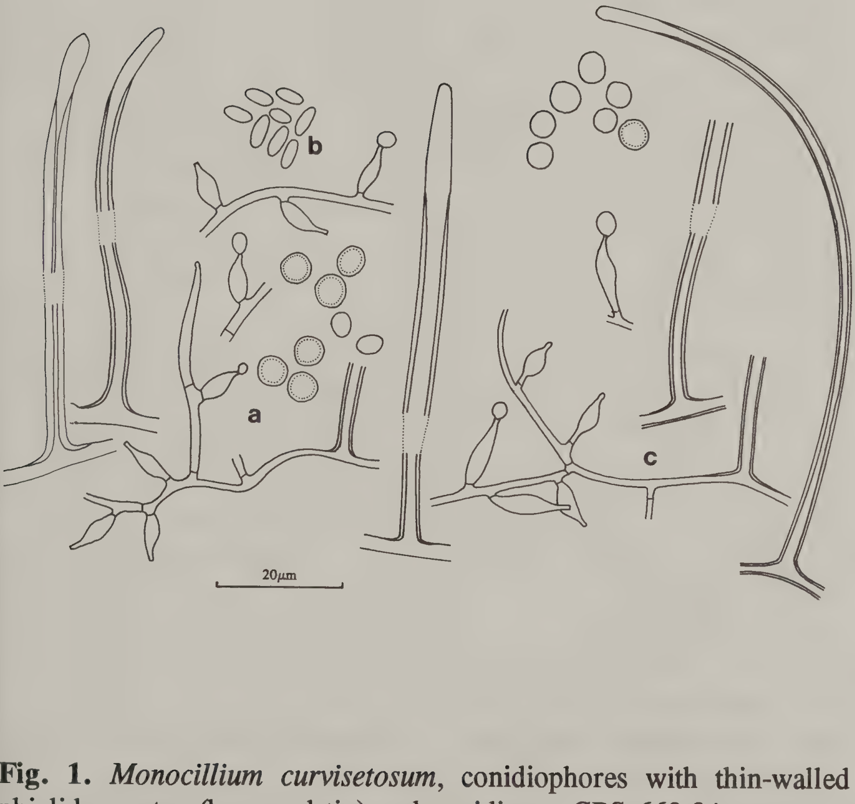

Fig. 1. *Monocillium curvisetosum*, conidiophores with thin-walled phialides, setae (base and tip) and conidia. a. CBS 660.94 grown on OA for 15 days, b. ellipsoidal conidia formed on SEA after 12 days; c. VTT D-95456, grown on OA for 8 days.

Material examined:

CBS 660.94, isolated from an aphid, Izmir, Türkiye, Feb. 1994.
VTT D-95456, VTT D-95457, VTT D-95460, from recycled fibre pulp mass, Finland, 1994, preserved in VTT Culture Collection, Espoo, Finland, commun. M.-L. Suihko.

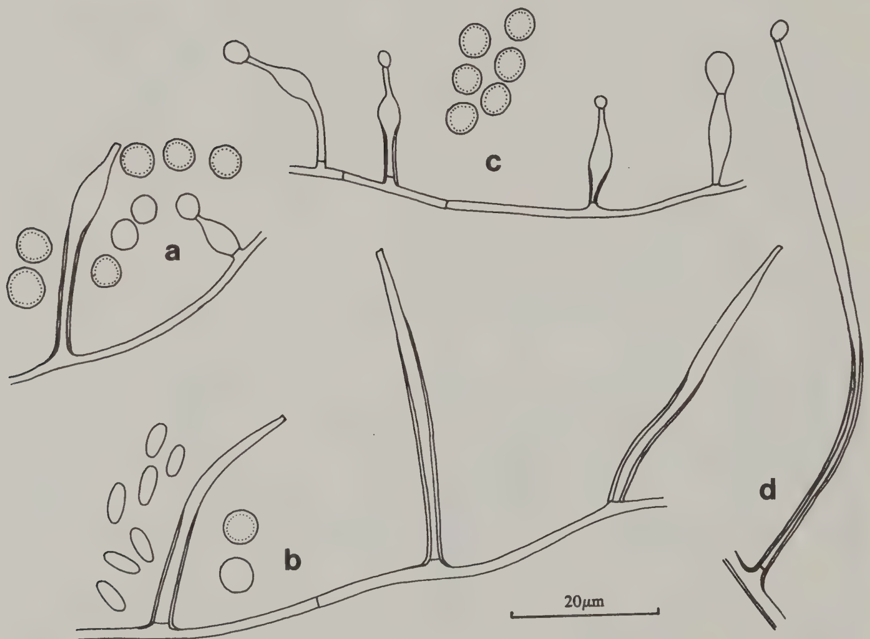

Fig. 2. *Monocillium curvisetosum*, conidiophores, some phialides with a thick-walled stalk, intermediate to the formation of setae, and conidia. a. VTT D-95457, grown on OA for 8 days; b. VTT D-95460 grown on PCA for 30 days, c. the same grown on OA for 34 days; d. slender, thick-walled phialide seen in VTT D-95456 on OA after 8 days.

Discussion

The structures otherwise functioning as thick-walled phialides in *Monocillium*, seem to have lost their sporulating function in the present fungus and to be transformed into curved sterile setae; the sporulating capacity is assumed by much smaller, broadly swollen, thin-walled phialides. We considered that this functional change might justify the erection of a separate genus for the present fungus. In all likelihood, however, the setae can be regarded as being derived from phialides as found in other species of *Monocillium*, so that the exclusion of *M. curvisetosum* from the genus would make *Monocillium* paraphyletic. Moreover, the stipe of the thin-walled phialides shows considerable variation in length, the longer ones being often considerably thick-walled and thus still fit *Monocillium.*

Within this genus the closest species to the new taxon seems to be *M. dimorphosporum* W. Gams (1971). This is the only species with comparable globose conidia (4.8–5.5 μm diam), but it regularly also produces ellipsoidal to allantoid conidia, both kinds on 55–85 (–130) μm long, slender and moderately thick-walled phialides. Short, broadly swollen and thin-walled phialides are absent in the only available culture, CBS 785.69, which has a similar temperature relationship as *M. curvisetosum* but grows slightly faster at 27–30°C. In *M. curvisetosum*, similar ellipsoidal conidia appeared regularly on phialides comparable to those of *M. dimorphosporum*, only in colonies grown on meagre media. Another fungus having similarly differentiated setae with broadened, thin-walled tips and short, swollen phialides has been described as *Pulvinotrichum capitatum* B. Sutton (1989), though its conspecificity with the type species, *Pulvinotrichum album* Gamundí, Arambarri & Giaiotti (1981), which lacks such setae, appeared unlikely. Crous *et al.* (1994) transferred this species to the new genus *Vesicladiella* and recognized that *Pulvinotrichum* was a synonym of *Cylindrodendrum* Bonorden. As long as no living culture of this species is available, a formal transfer of this fungus to *Monocillium* is not yet proposed.

Mating of the available cultures in all possible combinations on OA and PCA did not yield any perithecia.

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MYCOTAXON

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THREE NEW AND INTERESTING SPECIES OF *PSEUDOCERCOSPORA* FROM INDIA

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ABSTRACT

Pseudocercospora millingtoniae sp. nov., *Pseudocercospora syzygii* comb. nov. and *Pseudocercospora acalyphae* were described and illustrated.

Three severe foliar diseases were recorded on three different host plants growing in Nagarjunanagar area, viz., *Millingtonia hortensis* (Bignoniaceae); *Syzygium jambos* (Myrtaceae) and *Acalypha indica* (Euphorbiaceae). These were mainly observed during October-February period. *Pseudocercospora millingtoniae* , on *Millingtonia hortensis* is a new fungal species. *Cercospora syzygii* on *Syzygium jambos* is transferred to *Pseudocercospora* and *Pseudocercospora acalyphae* on *Acalypha indica* is described and discussed in detail.

a) *Pseudocercospora millingtoniae* Raghu Ram & Mallaiah spec. nov.

Maculae suborbiculares vel angulares, discretae vel confluentes, chloroticae vel pallido-brunneae, plerumque zona irregulari flavida lateque cinctae. Caespituli amphigeni, plerumque epiphylli. Stromata plerumque parva, pallide brunnea, usque 10 µm lata. Conidiophora 2-6, raro usque 10,

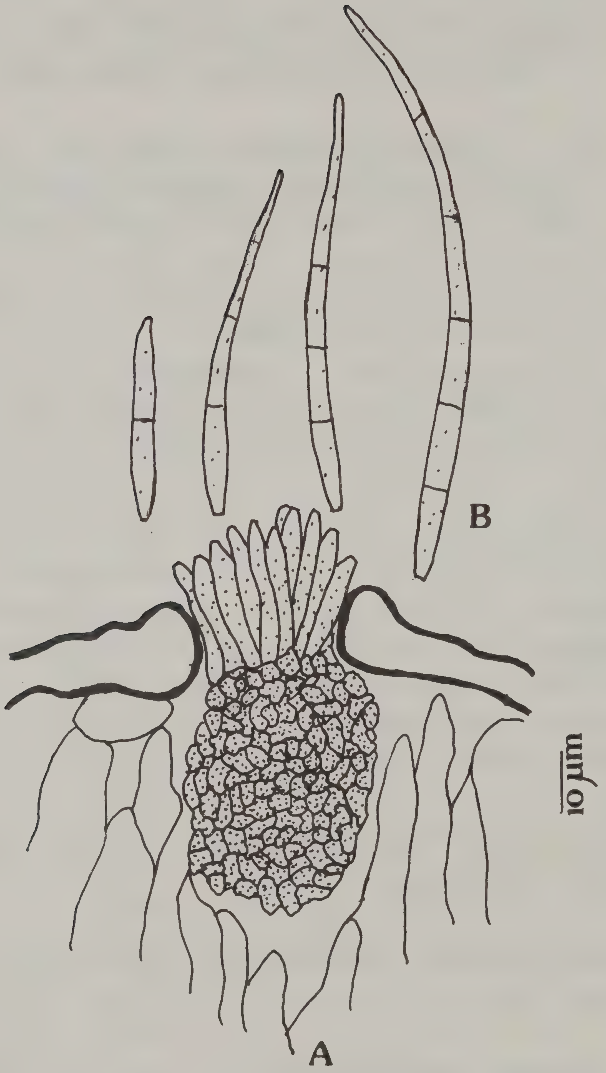

Fig. 1. *Pseudocercospora millingtoniae* : A. stroma with fascicle of conidiophores; B. conidia.

in fasciculo, pet stoma emergentia, olivacea vel modice brunnea, laevia, plerumque simplicia raro ramulo brevi, 2.5-3 um lata, 20-38 µm longa et non septata, cicatrices conidiales inconspicuae, circa 1.5 µm diam. Conidia pallidissime olivacea, obclavato- cylindrica, plerumque leniter curvata, laevia, 2-5 septata, non constricta (30-) 5-95 (-125) x 2.5-3 µm, apice obtusa, basi obcalvato-truncata.

Holotypus : on *Millingtonia hortensis* L. (Bignoniaceae), India, Guntur, A.P., 20.12.1990, Raghu Ram, IMI 344162.

Leaf spots subcircular to angular, discrete or confluent, chlorotic to pale brown in colour, mostly surrounded by a broad irregular yellowish zone. Stromata usually small, pale brown, up to 10 µm wide. Conidiophores 2-6 rarely up to 10 in fascicles emerging from stomata, olivaceous to medium brown, smooth, usually simple rarely branched, 2.5-3 x 20-33 µm long and non-septate, conidial scars inconspicuous. Conidia very pale olivaceous, obclavato-cylindrical, usually slightly curved, smooth, 2-5 septate, not constricted at septa, (30-) 5-95(-125) x 2.5-3 µm in size. Fig.1.

P. millingtoniae differs from *P. dolichondrones* (Chupp) Deighton, the only comparable species reported so far on members of the host family Bignoniaceae. The later can be differentiated by its large stroma (30 x 20 µm size), broad conidiophores (3-4 µm wide) and short conidia (25-75 µm in length).

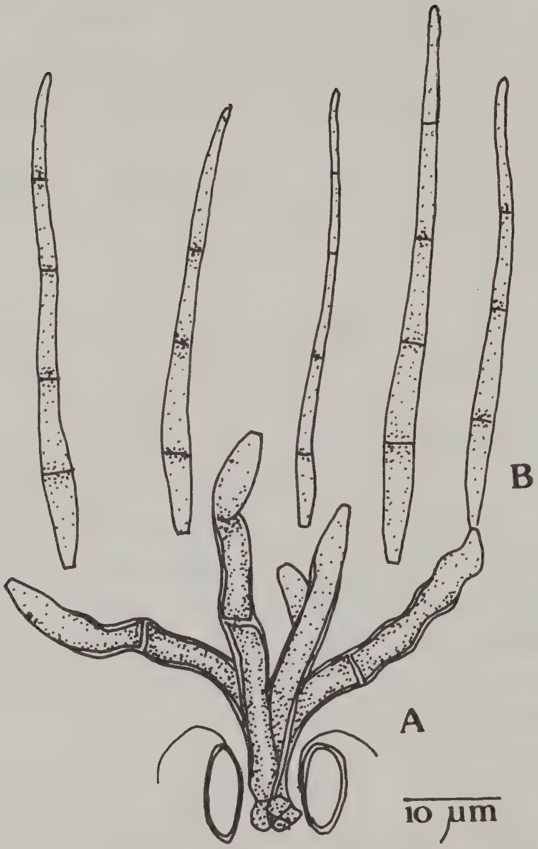

Fig. 2. *Pseudocercospora syzygii* : A. fascicle of conidiophores; B. Conidia.

On this host species there were no previous records of occurence of either *Cercospora* or *Pseudocercospora* foliar diseases (Pollack, 1987). Singh (1980) recorded (*Pseudocercosporella strebli (= Pseudocercospora strebli* (Singh) U.Braun, 1994), described on *Streblus asper* (Moraceae) from India, on *Millingtonia hortensis*. This record seems to belong to the present new species.

b) *Pseudocercospora syzygii* (M. Mandal) Raghu Ram & Mallaiah, comb. nov.

Bas. : *Cercospora syzygii* M.Mandal, *Ind. J. Mycol. Res.* 16 (2) : 313, 1978.

Leaf spots at first yellow, sub- angular, up to 4 mm wide, later turning to purplish red, irregularly angular spots. Caespituli mostly hypophyllous, pale brown. Stromata none. Conidiophores 3-8 in loose fascicles, pale to moderately olivaceous, divergent, sinuous, simple, septate emerging through stomata, 25-45 x 3.4 µm. Conidial scars inconspicuous. Conidia pale to moderately olivaceous, obclavato- cylindrical, smooth, thin walled, straight to slightly curved, 0-5 septate, not constricted, 10-70 x 3-4 µm. Fig. 2.

On leaves of Syzygium jambos (L.) Skeels (Myrtaceae), India, 19.01.1992. Raghu Ram, IMI 351222.

The fungus was originally described as *Cercospora syzygii* by M. Mandal on leaves of *S. cumini*. However, this was incorrectly placed in *Cercospora*. The presence of coloured conidia with unthickened spore scars and conidiophores without thickened scars, clearly supports the transfer of this fungus to *Pseudocercospora*.

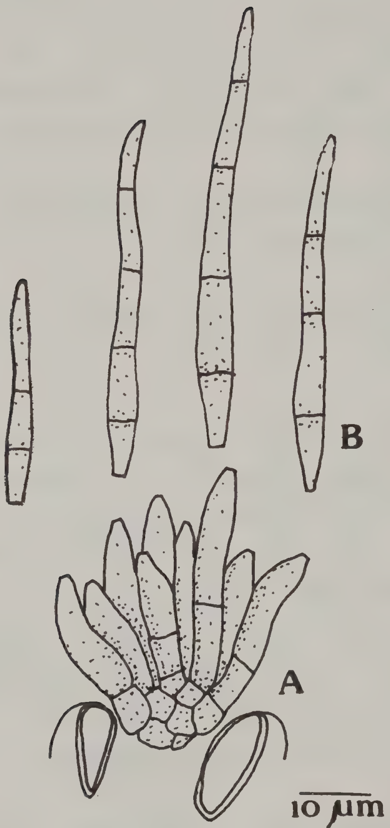

Fig. 3. *Pseudocercospora acalyphae* : A. fascicle of conidiophores ; B. Conidia.

Cercospora eugeniae (Rangel) Chupp, the only other species reported on this host genus, clearly differs from *P. syzygii* by its well developed stroma (30-60 µm in diam.) and densely fasciculate numerous conidiophores.

c) *Pseudocercospora acalyphae* (Lacy & Thirum.) Raghu Ram, Mallaiah & Braun, in Braun (1995, p.100)

Syn. : *Cercosporella acalyphae* Lacy & Thirum., *Sydowia,* 5, p.127, 1951. *Cercospora acalyphincola* Petrak, *Sydowia,* 10, p.122 (1956). *Cercospora gangetica* Pavgi & Singh, *Mycopathol. Mycol. appl.* 23, p. 189 (1964). *Cercospora acalyphicola* ("acalyphaecola") Yen, *Rev. Myc*. 31, p.112 (1966). *Pseudocercospora acalyphincola* (Petrak) Deighton, *Mycol. Pap.* 140, p.138 (1976). *Pseudocercospora acalyphicola* (Yen) Yen, *Gdn's Bull*, Singapore 33, p.168 (1980).

Leaf spots orbicular to suborbicular, amphigenous, at first appearing as yellow discoloured patches of 2-6 mm diam., discrete, evenly distributed all over the lamina, later turning to pale dark brown on the upper surface and grey below; fruiting amphigenous, mostly epiphyllous. Stromata lacking. Conidiophores emerging through the stoma, short, thin-walled, smooth, sub- cylindric, usually simple, pale to very pale or almost so; conidiogenous cells proliferate sympodially, the old scars are indistinct and unthickened, 10-25 x 2.5-3 µm. Conidia subcylindric to obclavato-cylindric, hyaline to sub-hyaline, smooth, thin-walled, indistinctly septate, broadly obtuse at the apex, slightly narrowed towards the truncate base, unthickened hilum, 25-65 x 2.5-3 µm. Fig.3.

On leaves of *Acalypha indica* (Euphorbiaceae), India, 22.01.1993. Raghu ram, HAL.

Castaneda & Braun (1989) recorded *Pseudocercospora acalyphincola* on *Acalypha havanensis* from Cuba and discussed the identity of *C. gangetica* and *C. acalyphicola.* There is undoubtedly only a single *Pseudocercospora* on *Acalypha*, well characterised by sub-hyaline conidia and pale conidiophores, at first subhyaline, later faintly pigmented (pale olivaceous to yellowish brown). The length of the conidiophores and conidia is fairly variable. *Cercosporella acalyphae* is the oldest valid name for this species.

Acknowledgements

We (MRR and KVM) are indebted to Dr.U.Braun for identification and valuable suggestions. We are also thankful to Dr.B.C. Sutton for identification of two specimens. One of us (MRR) is thankful to CSIR, New Delhi for financial assistance.

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A NEW SPECIES OF MONODICTYS FROM SOUTH AFRICA

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Abstract

Monodictys capensis R.C. Sinclair, Boshoff and Eicker is described from collections made in the Western Cape region on dead, decorticated wood in advanced stages of decay. Morphological variation is described in a pure culture isolate.

KEY WORDS: *Monodictys capensis*; new species; South African fungi; culture morphology.

Introduction

Continued collecting and identifying of Hyphomycetes on woody substrates have led to the discovery of an undescribed species belonging to the genus *Monodictys* Hughes. The Western Cape region, being a winter rainfall area, was used for selecting collection localities for the May to September winter season because most other regions of South Africa are dry during the winter months. The dry winter regions have proved relatively unproductive for collecting Hyphomycetes inhabiting dead wood during these months (Sinclair, unpublished data).

Thirty-six species of *Monodictys* have been recognized (Castañeda Ruíz, 1985; Castañeda Ruíz & Kendrick, 1990; Holubová-Jechová & Mercado, 1986; Matsushima, 1971; Matsushima, 1975; Matsushima, 1985; Matsushima, 1993; Melnik, 1988; Melnik & Shkarupa, 1989; Misra & Srivastava, 1979; Rao & de Hoog, 1986; Schoknecht & Crane, 1983; Singh & Barde, 1985; Sutton & Alcorn, 1984). Morphological variation in other species of *Monodictys* is noted with reference to the characteristics distinguishing this new taxon.

Taxonomic Part

Monodictys capensis R.C. Sinclair, Boshoff & Eicker, sp. nov. (Figs. 1-14).

Coloniae effusae, atrobrunneae vel atrae. Mycelium partim superficiale vel plerumque in substrato submersum ex hyphis ramosis, septatis, pallide brunneis vel brunneis, laevibus vel verrucosis, 1.5 - 3 μm crassis compositum. Conidiophora micronemata vel semi-macronemata, mononemata, simplicia, recta vel flexuosa, pallide brunnea vel brunnea, verrucosa, ad 130 μm longa, 3 - 4 μm crassa, cellae

infrequenter apicem versus tumidiores, ad 5 μm crassae. Cellae conidiogenae monoblasticae, in conidiophoris incorporatae, terminales, determinatae, cylindricae, verrucosae, pallide brunneae vel brunneae. Conidia solitaria, acrogena, plerumque obovoidea vel pyriformia vel ellipsoidea vel subglobosa, interdum margine leviter irregulari, atrobrunnea vel atra; quum veterascunt, atrascentia, magis crassiparietina et verrucosiora cum areis irregularibus laevibus apicem versus, muriformiter septata, septa invisibilia quum matura, 30 - 100 μm longa, 17 - 60 μm crassa, interdum una vel pluribus cellis basalibus pallidioribus quam ceteris, interdum tumidis et ad 8 μm latis.

In cultura pura in agaro decocto tuberorum: Coloniae tarde crescentes, atrobrunneae vel atrae, marginibus brevibus tenuiter effusis, centro elevato, duro, compacto, facie inferiore atrobrunnea vel atra. Mycelium ex hyphis superficialibus et immersis, ramosis, septatis, confertim implicatus, verrucosissimus, 3 - 5 μm crassis compositum, atrascens et asperascens maturitate et habitu aerio. Cellae conidiophororum frequenter tumidae ad 8 μm crassae, interdum tumidae et ad septa leviter constrictae. Conidia irregularissima, frequenter pallide brunnea, maturitate atrobrunnea vel atra, ad 175 μm longa, 110 μm crassa, cellae basales pallidiores quam ceterae, tumidae ad 8 μm latae, cellae interdum ad septa leviter constrictae. Conidia matura subinde producentia tumores excrescentes, brunneas, laeves, irregulariter septatis, subglobosa ad 30 μm diameter, margini conidii insidentes.

In lignis emortuis decorticatis, Constantia Neck, Western Cape Province, South Africa, July 2, 1994, R.C. Sinclair, PREM 52106, holotypus.

On the natural substrate: **Colonies** effuse, dark brown to black. **Mycelium** partly superficial to mostly immersed in the substrate, composed of branched, septate, pale brown to brown, smooth to verrucose, 1.5 - 3 μm wide hyphae. **Conidiophores** micronematous to semi-macronematous, mononematous, simple, straight or flexuous, pale brown to brown, verrucose, up to 130 μm long, 3 - 4 μm wide, cells infrequently swollen to 5 μm wide towards the apex. **Conidiogenous cells** monoblastic, integrated, terminal, determinate, cylindrical, verrucose, pale brown to brown. **Conidia** solitary, acrogenous, mostly obovoid but also pyriform to ellipsoid to subglobose, with slightly irregular margins, dark-brown to black; becoming darker, thicker-walled, and more verrucose with age, with irregular, smooth-walled areas towards the apex, muriformly septate, septa obscured at maturity, 30 - 100 μm long, 17 - 60 μm wide, sometimes one or more basal cells more pale than the others, sometimes swollen to 8 μm wide.

Figs. 1-6. Light micrographs of *M. capensis* R.C. Sinclair, Boshoff & Eicker, sp. nov. 1. Growth habit on natural substrate. 2. Developing conidia on natural substrate. 3a. Mature conidia from natural substrate. 3b. Mature irregular conidia from natural substrate. 3c. Mature irregular conidia from culture. 4 - 5. Developing conidia in culture. 6. Partially differentiated swollen cells immersed in agar from colony margin on PDA.

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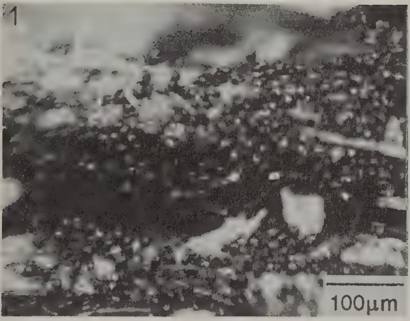

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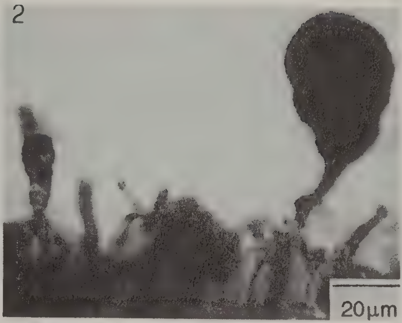

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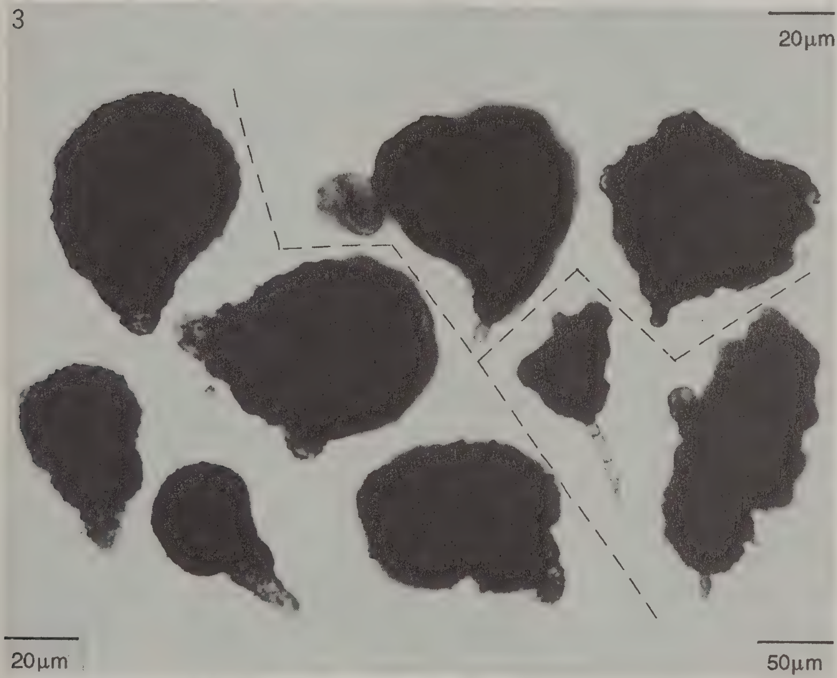
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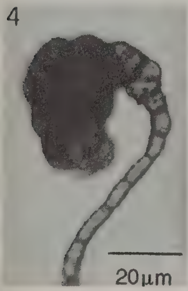

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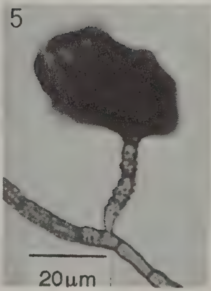

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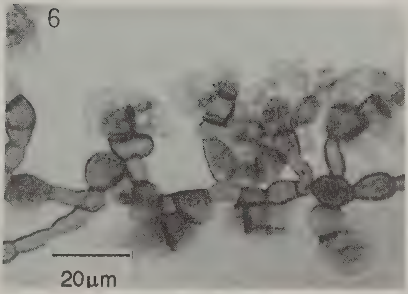

In pure culture on potato-dextrose agar: **Colonies** slow growing (10 mm in 21 days), dark-brown to black, short margins thinly spreading, center raised, hard, compact, reverse dark-brown to black. **Mycelium** composed of superficial and immersed, branched, septate, densely interwoven, densely verrucose, 3 - 5 μm wide hyphae, increasing in darkness and roughness with maturity and aerial growth. **Conidiophore** cells often swollen to 8 μm wide, sometimes slightly constricted at the septa. **Conidia** very irregular, often pale brown, dark-brown to black at maturity, up to 175 μm long, 110 μm wide, basal cells paler than the others, swollen to 8 μm wide, cells sometimes slightly constricted at the septa. Mature conidia occasionally developing brown, smooth, irregularly septate, subglobose growths on the conidium margin, up to 30 μm in diameter.

On dead, decorticated wood in advanced stages of decay; South Africa.

Collections examined: Western Cape region, wooded area near stream on roadside, Constantia Neck Road, Constantia Neck, South Africa, R.C. Sinclair, July 2, 1994, PREM 52106, holotype; in pure culture on potato-dextrose agar, PPRI 5984.

Discussion

The morphological features which are used to distinguish species in *Monodictys* i.e. conidiophore and conidium size; degree of pigmentation of conidiophore and conidium; and the wall ornamentation of the mycelium, conidiophore and conidium change with respect to the stage of development of the fungus. Rao and de Hoog (1986) suggest that the variability described in *M. lepraria* (Berk.) M.B. Ellis is due to the slow developmental process typical for the genus and the different stages of maturity seen. Many authors have addressed this issue by including descriptions of developmental changes: conidia of *M. anaptychiae* (Lindau) D. Hawksw. change from pale brown, thin-walled when young to dark brown, thick-walled with conspicuous, irregular ornamentation when mature (Hawksworth, 1975); conidia of *M. fluctuata* (M.P. Tandon & Bilgrami) M.B. Ellis are at first smooth, later becoming verruculose (Ellis, 1976) and conidia of *M. austrina* Tubaki are at first pale brown becoming dark brown to fuscous and rough when mature (Tubaki & Asano, 1965). However, a higher degree of pigmentation and verrucosity does not always correspond with increasing maturity in the darkly pigmented, dictyosporous species. In *Coniosporium peziza* (Cooke & Ellis) Mason & S. Hughes the young conidia are rough and the large, apparently mature conidia are almost perfectly smooth (Hughes, 1950). We, like Rao and de Hoog (1986), emphasized the description of the mature forms.

Figs. 7 - 14. Scanning electron micrographs of *M. capensis* R.C. Sinclair, Boshoff & Eicker, sp. nov. from natural substrate. 7. Effuse colony. 8. Developing conidium. 9 - 10. Fragmented conidia demonstrating thick wall and muriform septation. 11. Conidium release point. 12. Smooth apex of mature conidium. 13. Ellipsoid conidium. 14. Conidium with irregular margin and narrow basal cells.

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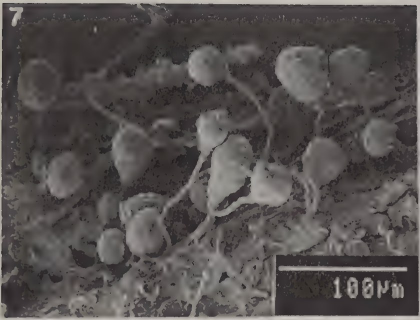

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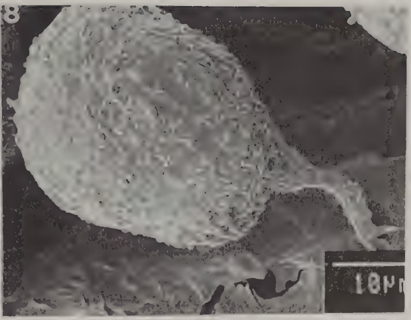

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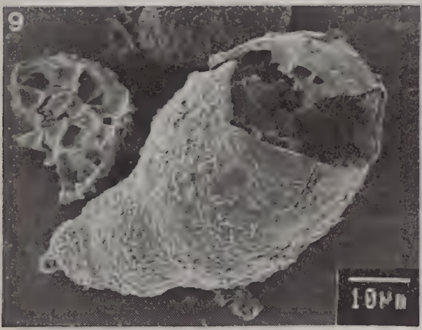

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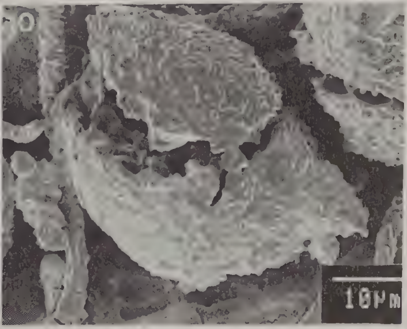

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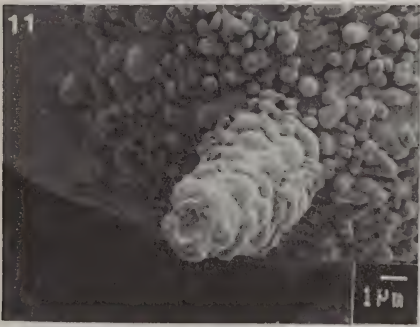

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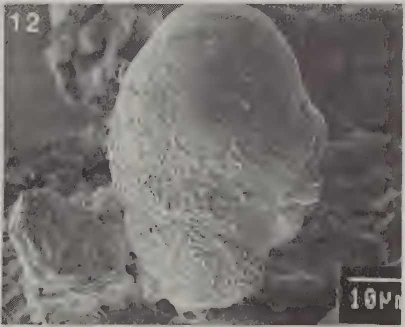

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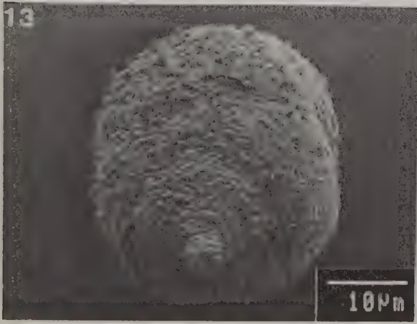

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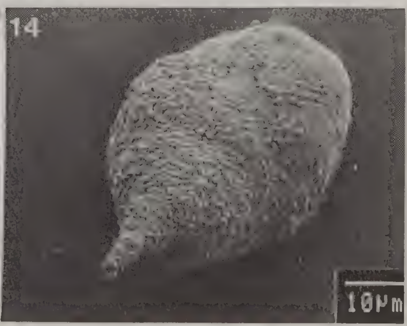

Hughes (1958), in the original generic description of *Monodictys* and designation of *M. putredinis* (Wallr.) S. Hughes as the type, did not address ornamentation of either the mycelium or conidiophore wall, but declared that the conidia may have either smooth or verruculose wall texture. Ellis (1976) described the genus as having smooth conidiophore walls, which is the case for many of the members, however, this does not appear in the Latin diagnosis (Hughes, 1958) and therefore should not be a precluding characteristic. Thus, the conidiophore wall ornamentation is acceptable in *M. capensis* as well as in *M. abuensis* (Chouhan & Panwar) Vasant Rao & de Hoog, where the conidiogenous cells are smooth or slightly verrucose (Rao & de Hoog 1986) and *M. torulosa* Misra & Srivastava , where the conidiophores are smooth or occasionally verrucose (Misra & Srivastava, 1979).

Pigmentation, verrucosity, conidiophore cell size and conidium size and degree of irregularity are increased in artificial culture specimens of *M. capensis*. Constrictions at the septa are also more pronounced. The constrictions may be due to cell volume expansion after cross-wall formation as a result of improved cytoplasm transport through the thallus in artificial culture, which may also be responsible for the general increase in size and intensity of the characteristics mentioned. Matsushima (1975) found the mycelium of *M. nigra* Matsush. to be smooth to verruculose in artificial culture while the entire fungus was smooth on the natural substrate. Ellis (1976) described *M. antiqua* (Corda) S. Hughes with verruculose conidia, whereas Rao & Reddy (1978) named a collection of this fungus which is entirely smooth Verrucosity in a similar genus, *Pithomyces* Berkeley & Broome, has been used to separate species, but only under well-defined temperature and nutrient conditions and developmental stage (Marasas & Schumann, 1972). In *M. capensis,* verrucosity of the conidiophore is a consistent feature appearing in specimens from artificial culture as well as from the natural substrate (Figs. 4, 5 & 8). Swelling of the conidiophore cells is rare on the natural substrate, however, the characteristic predominates when the fungus is grown in artificial culture. This brings into question the definitive value of these distinguishing features when it is apparent that growth conditions have an influence. Thus, the full range of characteristics, with emphasis on the obvious distinguishing features, have to be considered when attempting to make a diagnosis. Applying relative importance to specific characteristics must be avoided until relationships between particular anamorph characteristics and the identity of the teleomorph and/or other more important ecological or physiological characteristics can be ascertained.

Monodictys capensis is easily distinguished by conidium size and surface texture as well as the irregularity of conidium shape. Irregular conidium shapes also occur in *M. antiqua*, *M. castaneae* (Wallr.) S. Hughes, *M. fluctuata*, *M. indica* S.M. Singh & Barde, and *M. lepraria*. These species differ from *M. capensis* in that: *M. antiqua* has mostly clavate, obclavate or palmate conidia and condia and conidiophores are smooth; *M. castaneae* has smaller (maximum length and width, 40 x 25 μm) and thinner-walled conidia (Ellis, 1971); *M. fluctuata* has smaller (maximum 40 μm diameter), mostly subspherically shaped conidia which are verruculose only at maturity (Ellis, 1976); *M. indica* has smaller (maximum length and width, 75 x 65 μm), smooth conidia and the conidia and conidiophores have a greenish blue pigmentation in the cytoplasm (Singh & Barde, 1985) and *M. lepraria* has sometimes lobed conidia, the conidia and conidiophores are less pigmented and are smooth (Ellis, 1976; Rao & de Hoog, 1986). The irregular conidium forms in *M. capensis* are most frequent and exhibit the greatest variability in artificial culture. Other species similar to *M. capensis* are *M. paradoxa* (Corda) S. Hughes and *M. putredinis*. *M. paradoxa* has ellipsoidal, pyriform or subspherical conidia occurring in effuse colonies on the natural substrate. The conidia are dark, often with swollen and pale basal cells and frequently constricted at the conidium septae which are all similar to *M. capensis*, however, the conidia of *M. paradoxa* are smooth and much smaller (maximum length and width, 43 x 32 μm) (Ellis, 1971; Hughes, 1950). *M. putredinis* also has ellipsoidal, pyriform or subspherical conidia but they too are smooth and smaller (maximum length and width, 32 x 25 μm) (Ellis, 1976) than *M. capensis*. *M. putredinis* has a variably punctiform to spreading colony habit on the natural substrate as opposed to the effuse nature of *M. capensis.* Other species with conidium shapes similar to *M. capensis* are *M. monilicellularis* Matsush., *M. nigra* Matsush., and *M. bogoriensis* (Penz. & Sacc.) S. Hughes. These species, however, are all sporodochium forming and their conidia differ from the conidia of *M capensis* in size and and wall ornamentation. The conidia of *M. monilicellularis* are smooth and smaller (maximum length and width, 45 x 27 μm) (Matsushima, 1975) than those of *M. capensis*; those of *M. nigra* are also smooth and smaller (maximum length and width 37 x 23 μm) (Matsushima, 1975) and those of *M. bogoriensis* are slightly more ellipsoidal to ovoid in shape and also wider (23.5-53 μm) and shorter (31.5-79 μm) (Moore, 1959) than those of *M. capensis* .

In pure culture isolates of *M. capensis,* outgrowths on mature conidia are occasionally formed similar to those described for *M. gemmipara* Vasant Rao & de Hoog (Rao & de Hoog, 1986). The authors used the term "secondary conidia" to describe the outgrowths, yet give no indication whether or not they can function as conidia i.e. for growth or dispersal. The nature of these structures in *M. capensis* has, also, not been determined.

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TWO NEW SPECIES OF THE GENUS MENEGAZZIA (PARMELIACEAE SENSU LATO, LICHENIZED ASCOMYCOTINA) FROM SOUTHERN SOUTH AMERICA

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ABSTRACT

Two new sorediate species in the genus ***Menegazzia*** A. Massal. are described, both based on Argentine collections. The rare ***M. fumarprotocetrarica*** Calvelo & Adler may well represent the sorediate counterpart of ***M. conica*** P. James while ***M. norsorediata*** Adler & Calvelo with medullary norstictic acid, could be the sorediate counterpart of either ***M. pulchra*** P. James & D. J. Galloway or ***M. norstictica*** P. James.

INTRODUCTION

The present paper is a further contribution to the knowledge of the lichen flora of the southern South American ***Nothofagus*** forests and is based mainly upon studies of collections by the authors and comparison with herbarium material. Previous results on Parmeliaceae s. lat. have been reported elsewhere (Calvelo & Adler, 1992; Adler & Calvelo, 1993; Calvelo, 1996). Here, two new species of ***Menegazzia*** A. Massal. are described from the study area. The South American representatives of this genus are poorly known, there being few published contributions (Santesson, 1942; Calvelo & Adler, 1994).

MATERIAL AND METHODS

The present specimens were collected from the following localities: near the northern limit of ***N. dombeyi*** and ***N. pumilio*** forests (around 41° S) at approximately 800 m above sea level; and Tierra del Fuego (around 54° S), at the southernmost limit of ***N. pumilio***, between sea level and 100 m altitude. The collections of the species described here are housed at BAFC, BCRU (Herbarium of Centro Regional Universitario Bariloche) and in the personal herbarium of Calvelo. Collections of related species from BAFC, BCRU, H, LIL, S, SI, and UPS were also examined.

The specimens were studied morphological and anatomically by the usual methods for such foliose lichens (Adler & Calvelo, 1993). Lichen substances were identified by TLC (Elix et al., 1987) and comparison with authentic samples. Habit photographs were taken on a Olympus SZH dissecting microscope, with Olympus camera.

The abbreviations for most herbaria correspond to "Index Herbariorum" (Holmgren et al., 1990). BCRU refers to the Herbarium of Centro Regional Universitario Bariloche. The authors´ names follow Brummit and Powell (1992).

THE SPECIES

Menegazzia norsorediata Adler & Calvelo
Fig 1.

Species cum thallo et substantiis ut in ***Menegazzia norstictica*** sed ab haec species presentia soraliorum laminarium et sorediorum marginibus foraminum differt.

Typus: Argentina, Prov. de Tierra del Fuego: 10 km from the intersection of Moat river and the route from Moat to Ushuaia, on rock in ***N. betuloides*** forests, facing the sea, XI- 1993, S. Calvelo & M. T. Adler (BAFC 37732-Holotype).

Etymology: The specific epithet is composed by "nor" referred to norstictic acid and "sorediata", to the presence of soredia.

Thallus saxicolous or corticolous, appressed, up to 5 cm wide. Lobes radiating, contiguous to the periphery, dichotomously branched, 1.5-1.7 mm wide and 2.5-5.5 (-6.5) mm long. Upper surface smooth, white, maculate; glossy at the apices, becoming rugose and matt at the centre, pale grey to grey, sometimes blackened laterally; perforations laminal, up to 1.5 mm diam., more or less frequent, medium, linearly arranged, rounded or elliptical; sorediate, soralia capitate to subcapitate, frequently confluent, laminal in the median line of the lobes and not associated with the perforations, rarely developing from the margin of the perforations into the cavity; soredia granular, white to pale orange. Central cavity with elliptic to flat rectangular section. Medulla white to pale cream with occasional orange patches near the apices, brown to blackish in older parts. Lower surface black to dark brown. Apothecia unknown. Pycnidia very rare, immature. Conidia unknown.

Chemistry: Upper cortex K+ yellow (atranorin, major to trace). Medulla K+ at first orange, finally red, C-, KC- (norstictic acid, major).

Additional specimens examined: **ARGENTINA**; Prov. de Río Negro, Bariloche, Llao Llao, way from Soria Moria to Lago Escondido, on ***N. dombeyi***, 7-X-1993, leg. S. Calvelo, 00756 (BCRU). Bariloche, Llao Llao, pathway from Soria Moria to Lago Escondido, on ***N. dombeyi***, 28-V-1995, leg. S. Calvelo, 37863 (BAFC). Prov. de Tierra del Fuego, near Tolhuin, in a very humid ***N. pumilio*** forest, on ***N. pumilio***, XI-1993, Calvelo & Adler 37722 (BAFC), 00683 (BCRU).

Remarks: The presence of norstictic acid as the predominant medullary substance indicates that ***M. norsorediata*** might be related to either of the following esorediate taxa: *M.* ***pulchra*** P. James & D. J. Galloway, which is endemic from New Zealand (Galloway, 1985) and has 8-spored asci; or *M.* ***norstictica*** P. James which is endemic from Australia and has 2-spored asci (James & Galloway, 1992). The thallus morphology of ***M. norsorediata*** corresponds better with *M.* ***norstictica*** but, as apothecia of the new species are unknown, it is not possible to decide which is the more likely parent species.

At present ***M. norsorediata*** is known from southern South America, where it was collected in the Argentinian Provinces of Río Negro and Tierra del Fuego, growing on rocks and on ***Nothofagus*** spp.

Menegazzia fumarprotocetrarica Calvelo & Adler
Fig. 2

Species cum thallo et substantiis ut in ***Menegazzia conica*** sed ab haec specie presentia soraliorum laminarium vel marginalium differt.

Typus: **Argentina**, Prov. de Río Negro, Bariloche, Llao Llao, pathway from Soria Moria to Lago Escondido, on ***N. dombeyi***, 7-X-1993, leg. S. Calvelo (BAFC 37861-Holotype).

Etymology: The specific epithet refers to the presence of medullary fumarprotocetraric acid, a rare substance in ***Menegazzia.***

Thallus corticolous, firmly attached, up to 3 cm wide. Lobes short, up to 11 mm long and 2 mm wide, irregularly inflated; sparingly branched, occasionally with short lateral branches. Upper surface grey to greenish-grey; perforations frequent throughout, circular to irregular, up to 1.5 mm diam., with raised margins; sorediate, soralia up to 1.4 mm diam., laminal or marginal, formed on large protuberances from the upper surface, protuberances closed initially, then developing numerous small holes and finally bursting open to show white granular, soredia. Central cavity with circular to elliptic section. Medulla white in the upper side, black in the lower one. Lower surface black. Apothecia unknown. Pycnidia unknown.

Chemistry: Upper cortex K+ yellow (atranorin, minor). Medulla K-, C-, KC- (fumarprotocetraric acid, major).

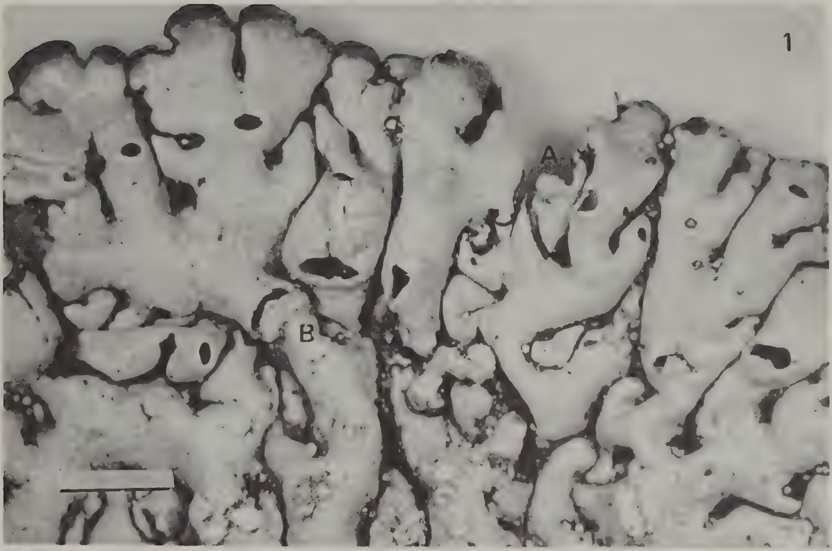
Additional specimens examined: **ARGENTINA**, Prov. de Río Negro, Bariloche, Villa Tacul, near the beach of Lago Nahuel Huapi, on ***N. dombeyi***, 6-IV-1992, leg. S. Calvelo, 00755 (BCRU). Llao Llao, pathway from Soria Moria to Lago Escondido, on ***N. dombeyi***, 28-V-1995, leg. S. Calvelo, 37862 (BAFC). Parque Nacional Nahuel Huapi, Isla Victoria, on ***N. dombeyi***, 27-I-1950, leg. I. Mackenzie Lamb 5837a, ex SI, 00339 (BCRU).

Remarks: At present, the only two species of ***Menegazzia*** known to contain medullary fumarprotocetraric acid are the Australian endemic, ***M. conica*** P. James (James, 1992), and the presently described taxon. It is possible that ***M. fumarprotocetrarica*** could represent the sorediate counterpart of ***M. conica***.

Up until now ***M. fumarprotocetrarica*** is only known from a very restricted area of the andino-patagonic forests of Río Negro Province, Argentina, where it grows on ***N. dombeyi***.

Fig. 1. ***Menegazzia norsorediata***, Holotype 37732 (BAFC) A- laminal soralium; B- soralium associated with a perforation (infrequent character). Scale = 3 mm.

Fig. 2. ***Menegazzia fumarprotocetrarica***, Holotype 37861 (BAFC). A- protuberances with holes, primordia of soralia. B- soralia. Scale = 3 mm.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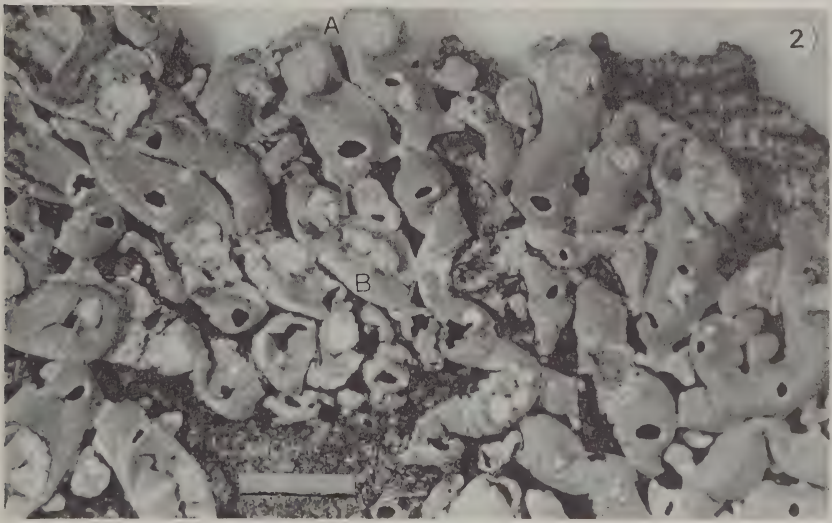
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2
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GLOMUS SPURCUM: A NEW ENDOMYCORRHIZAL FUNGUS FROM ARIZONA

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SUMMARY

A new species of endomycorrhizal fungus (*Glomus spurcum*) is described and illustrated. The fungus is known to form arbuscular mycorrhizae with at least eight species of plants. Intraradical vesicle formation by *G. spurcum* has not been observed. Intraradical hyphae can be enlarged and lobed in a manner similar to that described for a species of *Acaulospora.* The mycorrhizae formed by *G. spurcum* are similar to that of some species of *Acaulospora* but the gross morphology of the spores and spore development place it in *Glomus* as that genus is currently defined.

Spores of *Glomus spurcum* were found originally with *Acaulospora delicata* Walker, Pfeiffer & Bloss in a greenhouse bed of sand used for the propagation of various ornamental plants from stem cuttings. Cultures were obtained by extracting spores and mixing them with sterile sand which was then sown with seeds of *Sorghum sudanense* (Piper) Staph. (Walker, Pfeiffer and Bloss, 1986). Plants were maintained in a growth chamber (27 °C day : 15 °C night), illuminated with a mixture of fluorescent and incandescent light at approximately 96 μE m^{-2} s^{-1}. Additional pot cultures were later established with other grasses and some herbaceous annual plants, some of which were maintained for five years with no evidence of morphological change to the spores, regardless of plant or soil type. The species was also identified from natural environments in Arizona, Mexico and Hawaii.

The species description is made from light microscopy of specimens mounted in water, polyvinyl alcohol lactophenol (PVL) or polyvinyl alcohol lactoglycerol (PVLG) to which stains and reagents were added as required. The color of intact spores was determined from specimens in water, viewed at 20-50 X under a dissecting microscope with reflected light from a tungsten-halogen source having a color temperature of 3200 °K. The same light source was used to illuminate the color chart (Anon, 1969) for color-matching. Colors of individual walls are as viewed through a compound microscope with a color temperature of 3200 °K, matched with the color chart illuminated as for the dissecting microscope. Numbers in parenthesis after color descriptions refer to color numbers on the chart. Mycorrhizae were cleared and stained by a slightly modified Phillips and Hayman (1970) technique.

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Spores were also examined with a scanning electron microscope. Spores were fixed for 3 d in 1.5% glutaraldehyde-phosphate buffer, pH 7.0. After fixation, they were placed in a drop of water on a microscope slide and crushed gently by application of pressure to a glass cover slip. The broken spores then were removed and washed in distilled water, processed through an acetone series, 50-100% with a minimum of 15 min per dilution bath, placed in absolute ethanol for 1 h, and air dried. Sputter coating was for 120 s with gold-palladium (60:40). Coated spores were attached to the microscope stage with double sided adhesive tape after which a small sliver of adhesive tape was used to hinge open broken spores, thus allowing observation of the fractured walls.

We have used the term *wall* in the species description only as an aid for the description. Berch (1986) was correct in her criticism of the use of the term *wall* in describing species. Her proposal to substitute the word *layer* for wall is equally flawed, since the true nature of the walls and layers in spores of members of the Glomales is not yet completely understood. The terminology used by Morton (1995) for walls or wall layers in fruiting structures of members of *Scutellospora* moves towards clarifying this debate. With *G. spurcum*, we have been unable to determine the ontogenetic sequence of wall or wall layer production and have consequently retained the terminology of Walker (1983). Names of species in the Glomales follow Walker and Trappe (1993).

GLOMUS SPURCUM Pfeiffer, Walker & Bloss sp. nov. Figs. 1-3.

Sporocarpia ignota. Chlamydosporae singulae vel laxe fasculatae in solo (57-)75-110(-130) x (40-)75-110(-115) μm, globosae vel subglobosae interdum ovoideae vel obovoideae, hyalinae, sporarum tunica tristratis. Hypha affixa obscura. Sporae et hyphae cum mucosa exteriore.

SPOROCARPS unknown.

SPORES formed singly or aggregated in soil, terminally on thin-walled, coenocytic or sparsely septate hyphae; globose to subglobose (rarely ovoid to obovoid or irregular), (57-)75-110(-130) x (40-)75-110(-115) μm. Infrequently formed in the cortical cells of roots. At maturity, usually becoming detached from the sporogenous hyphae. Spore color in water with reflected light, hyaline with a "frosted" appearance caused by the roughened nature of a mucilaginous material covering the outer wall. Spores often appearing dirty and adopting the color of the substrate because of adherent soil particles (Fig. 2A).

SPORE WALL STRUCTURE of three walls (walls 1-3), in three groups (A, B and C), each with a single wall (Fig. 1, Fig. 2F). Wall group A of a single, hyaline to very pale yellowish cream (3) somewhat flexible unit wall (wall 1), 0.25-0.75 μm thick, covered in older spores by a mucilaginous material, 0.5-4 μm thick, which appears to be formed by overlapping plate-like structures when examined with the scanning electron microscope (Fig. 2H). When some specimens are mounted in water, PVL or PVLG, wall 1 with its mucilaginous covering rapidly separates from wall 2, producing a balloon-like effect (Fig. 2B); the thickness of wall 1 and its mucilaginous covering remain unchanged. Wall group B of a single, laminated wall (wall 2), hyaline to lightly colored, (1.5-)2.0-4.0(-5.0) μm thick with up to 10 subequal laminations that may be so thin as to be difficult to detect (Figs. 2F & 2G). Wall group C of a single, very thin hyaline membranous wall (wall 3), less than 0.5 μm thick, often adherent to wall 2, and thus difficult to detect (Fig. 2F). Wall 3 reacting quickly in Melzer's reagent to become greenish yellow (57), whereas the colors of other walls and the mucilaginous material are unchanged in this reagent. The mucilaginous material and walls 1 & 3 cyanophilous in cotton blue; wall 2 not staining. Walls 2 & 3 sometimes appearing, by light microscopy, to form an endospore (Fig. 2E).

SUBTENDING HYPHAE straight (3.5-)4.0-5.0(-6.0) μm diameter, parallel-sided, not thickened at the spore base. Walls 0.5-1.0 μm thick, continuous with wall 1 of the spore and the mucilaginous outer material, often with adherent soil particles (Figs. 2A & 2C). The hypha shrivels and collapses at spore maturity and becomes difficult to see. Spore occlusion apparently by continuation of wall 2 at the spore base, giving the appearance of a septum (Fig. 2E). A thin septum may occur in the subtending hypha 17-35 μm from the spore base (Fig. 2C).

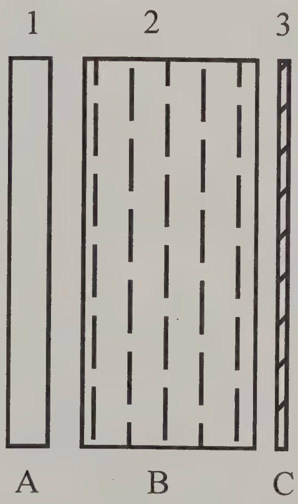


Fig. 1. Murograph (Walker, 1983) of *Glomus spurcum*. Spore wall structure of three groups (A B & C) each with a single wall (walls 1-3). Walls illustrated as: Unit wall 1, unshaded; laminated wall 2, broken lines; membranous wall 3, diagonal lines. The mucilaginous material covering spores is not illustrated in the murograph. Walls are numbered sequentially from outer to inner walls.

SPORE GERMINATION difficult to discern and not yet conclusively determined. Apparently by the development of a germination tube from wall 3, emerging directly through the outer walls. Details have been obscured by debris which adheres to the mucilaginous covering and wall degradation.

ETYMOLOGY: Latin - spurcum (dirty), referring to debris which adheres to the mucilaginous outer covering of spores and mycelium.

MYCORRHIZAE: sparse, poorly staining in cotton blue, trypan blue or acid fuchsin red; with broad intraradical hyphae and coarse arbuscules. No distinct intraradical vesicles have been observed, and no differences have been noted among mycorrhizae with different plant species (Figs. 3A-F).

MYCORRHIZAL ASSOCIATIONS: known to form a type of arbuscular endomycorrhiza with *Helianthus annuus* L., *Lycopersicon esculentum* Mill., *Medicago sativa* L., *Paspalum notatum* Flügge, *Plantago lanceolata* L., *Sorghum saccharatum* Moench., *S. sudanense*, and *Zea mays* L.

COLLECTIONS EXAMINED

HOLOTYPE: ARIZONA, Pima County, Tucson; from a pot culture with *S. sudanense* Walker (W989), (E); Isotypes OSC, ARIZ. The origin of the sand in the greenhouse at the University of Arizona (Building 42-2R) from which the original spores were extracted is unknown.

OTHER COLLECTIONS: ARIZONA, Pima County, Molino Basin, Santa Catalina Mountains, in the Encinal Region (Niering and Whittaker 1963); extracted from soil under mixed grasses (W912). ARIZONA, Pima County, Tucson; from a pot culture with *P. notatum* (W1659) and *P. lanceolata* (W1658) started with spores from the holotype culture. HAWAII, Kauai, Hanapepe; from the root zone of *Leucaena*

Fig. 2. Light micrographs (LM) and scanning electron micrographs (SEM) of spores of *Glomus spurcum*.

A. Spore mounted in PVL with intact subtending hypha (sh) with adherent debris (arrows) on the mucilaginous covering (LM).

B. Wall 1 and the mucilaginous covering "ballooning" when the spore was mounted in PVL on a microscope slide with cover slip. Innermost walls 2 & 3 unchanged (LM).

C. Intact subtending hypha with a septum (arrow) (LM).

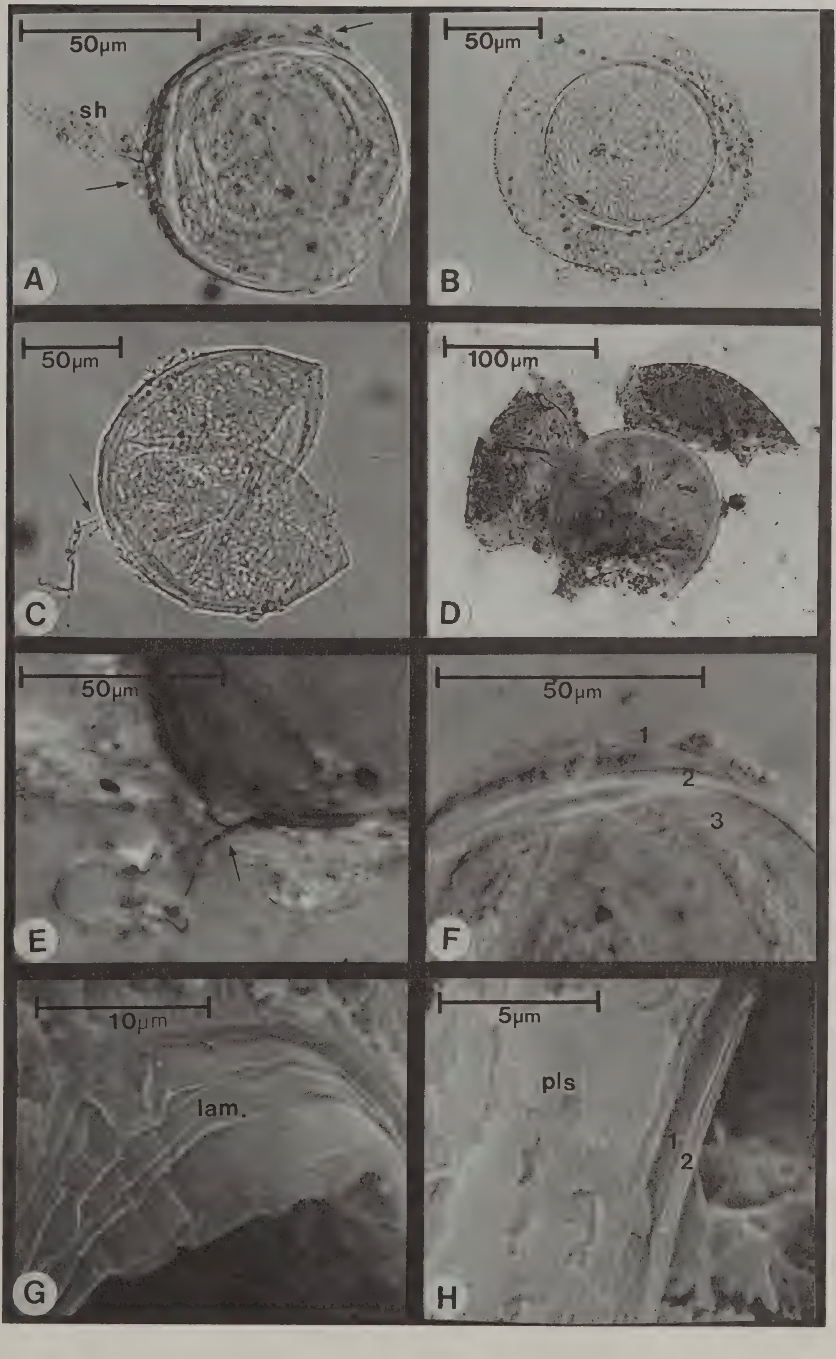
D. Outer wall (wall 1), and the mucilaginous covering separated from walls 2 & 3 upon crushing the spore on a microscope slide with a coverslip (LM).

E. Wall 2 invaginated (arrow) in the subtending hypha giving the appearance of walls 2 & 3 forming an endospore (LM).

F. Details of wall structure. Wall 1; outer, unit wall with mucilaginous covering and adherent debris. Wall 2; laminated wall. Wall 3; membranous wall often difficult to detect (LM).

G. Laminae (lam.) in wall 2 illustrated (SEM).

H. Apparent plate like structure (pls) of the mucilaginous material covering spores, walls 1 & 2 illustrated (SEM).


50µm
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leucocephala (Lam.) de Wit in sand dunes (W1574). MEXICO, west of Ciudad Obregon, Santa Maria Beach; from beach sand collected beneath *Abronia maritima* Nutt. Pot cultures were established from the Hawaiian collection (R. E. Koske and J. N. Gemma, University of Rhode Island - personal communication) and the Mexican collection (Pfeiffer).

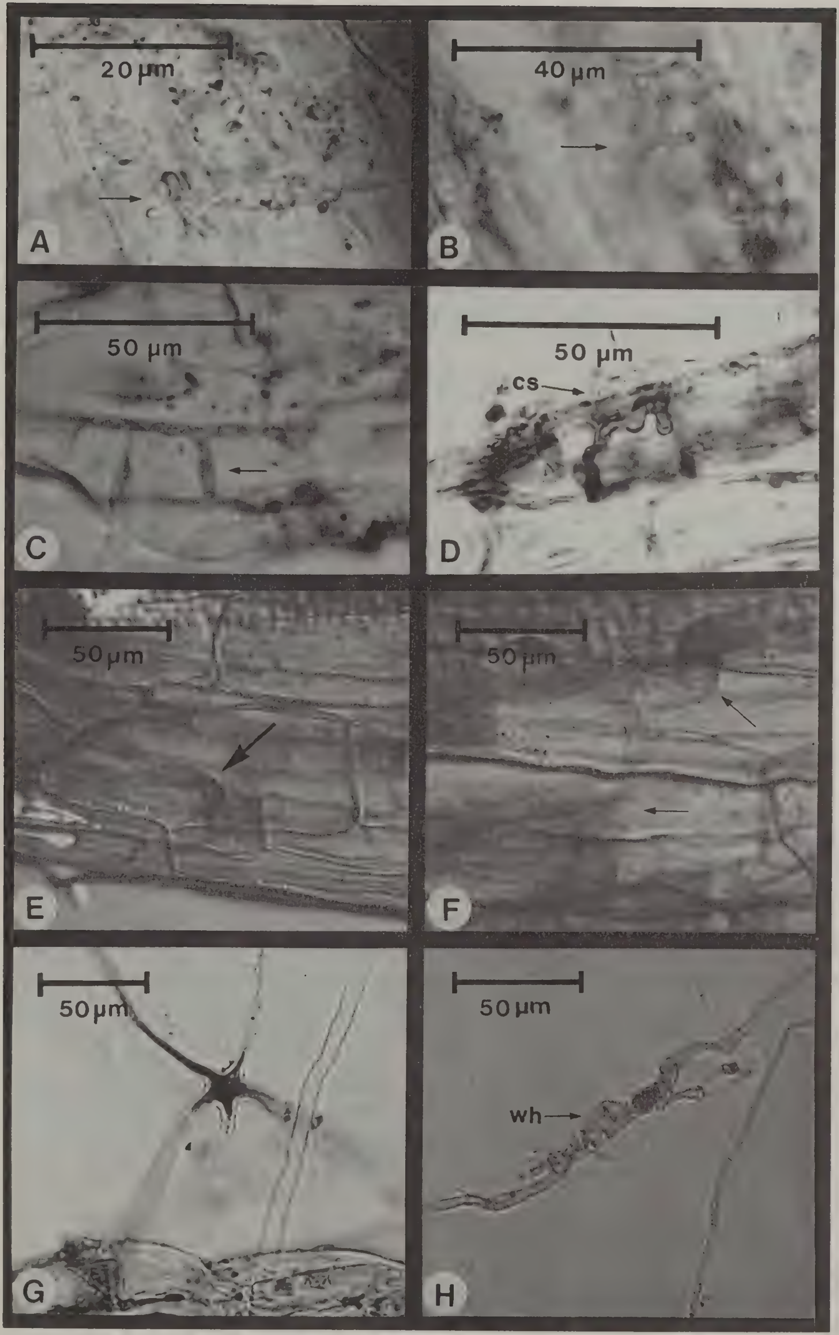
DISCUSSION

Glomus spurcum is a widespread species whose hyaline spores, wall structure, narrow hyphal attachment and mucilaginous covering of the outer wall readily separate this species from nearly all other members of the genus *Glomus*. A newly described species, *Glomus viscosum*, Walker et al. (Walker et al., 1995), has hyaline spores with an outer mucilaginous covering and a spore size similar to *G. spurcum*. Unlike *G. spurcum*, *G. viscosum* possesses a single wall with two layers and a persistent subtending hypha. The single wall and mucilaginous covering of *G. viscosum* is not flexible and does not balloon when mounted on microscope slides in water, PVL or PVLG. The spore size of *G. spurcum* and *G. viscosum* overlap; however, *G. spurcum* spores are generally larger, the maximum length being 130 μm compared with a maximum length of 97μm for *G. viscosum*. Spores of *Glomus albidum* Walker & Rhodes appear similar to those of *G. spurcum* at maturity but *G. albidum* is much larger, up to 198 x 177 μm compared with a maximum of 130 x 115 μm for *G. spurcum* and, *G. albidum* lacks an inner, membranous wall (Walker and Rhodes, 1981). Spores of *Glomus diaphanum* Morton & Walker, *Glomus laccatum* Blaszkowski, *Glomus lacteum* Rose & Trappe, *Glomus occultum* Walker and *Glomus scintillans* Rose & Trappe may appear superficially similar to those of *G. spurcum*, but all have spores with more prominent subtending hyphae, different wall structures and lack the persistent mucilaginous covering (Morton and Walker, 1984; Blaszkowski, 1988; Rose and Trappe, 1980; Walker, 1982). The unusual ballooning of wall 1 and attached mucilaginous material when some spores of *G. spurcum* are placed in mountants has not been recorded for any other member of the genus *Glomus*.

Spain (1990) made a plea for spore diagnoses of members of the Glomales to be made from spores mounted in water. Her arguments were largely based on the way that wall types are characterized. Certain types of walls are changed, microscopically and possibly chemically, dependent upon the pH or other chemical properties of different media. Because most of the more recent descriptions have been made from specimens mounted in polyvinyl alcohol-based, acidic mounting media, we have chosen to adhere

Fig. 3. *Glomus spurcum* mycorrhizas with *Plantago lanceolata* (Pl) or *Sorghum sudanense* (Ss) and extra-radical mycelium; light micrographs.

A & B. Coarse arbuscule-like structures (arrows) in cortical cells of Pl.
C. Intercellular hyphae forming "H-connections" (arrow) in root of Pl.
D. Colonization structure (cs) on root surface of Pl.
E. Coarse arbuscule like structure (arrow) in cortical cell of Ss.
F. Swollen internal mycelial structures and broad hyphae in root of Ss.
G. Extra-radical mycelium with a star-shaped hyphal junction.
H. Extra-radical mycelium showing a type of "wound-healing" (wh) response.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to that convention. Nevertheless, we are sympathetic to Spain's arguments, and consequently, have studied spores mounted in water. Spores of *G. spurcum* in water show only minor differences from those in PVL or PVLG. Wall 1 balloons more in PVL or PVLG than it does in water, though the phenomenon does not occur consistently in any mountant. The innermost flexible wall (wall 3) is easier to observe in water than in PVL or PVLG. Future species descriptions should perhaps include discussion of spores mounted in water as well as other media such as PVLG.

The genus *Glomus* Tulasne & Tulasne, as currently defined (Gerdemann and Trappe, 1974; Morton and Benny, 1990) is poorly delimited, and consists of an assemblage of species that are unlikely to be monophyletic. At least one species, *Glomus leptotichum* Schenck & Smith is considered to be a morph of *Acaulospora gerdemannii* Schenck & Nicolson (Nicolson and Schenck, 1979) (J. B. Morton, personal communication). *Glomus spurcum* differs in several ways from more typical species in the genus such as *Glomus macrocarpum* Tul. & Tul. It has the spore contents bounded by a membranous wall in a manner similar to that reported for *G. leptotichum* (Schenck and Smith, 1982). Spores appear to germinate by direct growth of a germ tube through the spore walls similar to that described for *G. albidum* (Walker and Rhodes, 1981) and *G. scintillans* (Rose & Trappe, 1980) rather than by regrowth through the subtending hypha. Details of germ tube formation and growth through walls of *G. spurcum* are difficult to discern because of debris which adheres to the mucilaginous covering and wall degradation.

The extra-radical mycelium of *Glomus spurcum* is typically coenocytic and has frequent coarse hyphal junctions with up to five branches (Fig. 3G). Occasionally, a type of wound-healing response, reminiscent of that found in members of the Gigasporaceae or in *Acaulospora nicolsonii* Walker, Reed & Sanders can be found (Fig. 3H) (Walker, Reed and Sanders, 1984). The mycorrhizae formed by this fungus are unusually sparse and poorly-developed for a species of *Glomus* (Figs. 3A-F). In a sample of roots from a pot culture with *M. sativa*, only 14 entry points were observed in 23.5 mm of root. In one pot culture with *P. lanceolata*, sporulation was abundant, but neither root staining nor observation by fluorescence microscopy revealed mycorrhizae. However, in another pot culture with *P. lanceolata*, mycorrhizae which stained very weakly with cotton blue were found. Vesicles have not been observed, and although arbuscules are produced, they consist of rather coarse hyphal elements; not typical of those described for *Glomus, Scutellospora* or *Gigaspora* spp. The mycorrhizae formed by *G. spurcum* are similar to those described for *G. leptotichum* (Schenck and Smith, 1982) and also resemble those illustrated for Abbott's isolate of an *Acaulospora* similar to *A. laevis* Gerdemann & Trappe from Badgingarra, Western Australia (Abbott, 1982; Figs 22 & 23). In the key to colonization patterns (Abbott, 1982), mycorrhizae of *G. spurcum* key out as members of the genus *Acaulospora*. *Glomus spurcum* may fulfil the criteria propounded by Morton (1990) for an "early progenitor species". Its hyphae are compatible with the plant roots in which they develop and it sporulates abundantly in pot culture from a poorly developed mycorrhizal base.

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MYCOTAXON

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PHELLINUS SPINESCENS SP. NOV. ON BAMBOO FROM SOUTH AMERICA

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Abstract:

Phellinus spinescens Wright & Coelho (Hymenochaetaceae, Aphyllophorales) is described as a new species within a small group of ***Phellinus*** living on bamboo. It is characterized by globose, dextrinoid spores and slender, long, ventricose setae frequently with subapical lateral spines.

Introduction:

Several species of fungi live on stems and leaves of bamboo. A small group of species of ***Phellinus*** appear to have a specificity for this substratum (Larsen & Cobb-Poulle, 1990; Lowe, 1963), viz.: ***P. bambusinus*** (Pat.) Pat., ***P. bambusarum*** (Rick) Larsen[1] and ***P. uncinatus*** Rajchenb. These have in common a resupinate habit, dextrinoid spores and hymenial setae, except ***P. bambusinus*** which has smaller non dextrinoid spores, and its fruitbodies may be resupinate to effused-reflexed. ***P. spinescens*** Wright

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[1] ***Phellinus garuhapensis*** Wright & Blumenfeld (1984) is, according to Rajchenberg & Meijer (1990), a taxonomic synonym of ***P. bambusarum*** (Rick) M. Lars. (Larsen & Cobb-Poulle, 1990).

& Coelho belongs to the same group by having the above features, but exhibits enough differences to warrant its separation as a different taxon.

A description of the latter species was given in Larsen & Cobb-Poulle, as an Addendum. This was based on material sent to Dr. M. Larsen by the junior author several years ago, found in the Iguazú Nat'l Park, Misiones, Argentina, on bamboo. The diagnosis was purported to be in Mycotaxon, in press. Actually, the holotype was later lost so the species name was never published. During a masters thesis of the senior author (Coelho, 1994), concerning the species of ***Phellinus*** of southern Brazil, several collections of ***Phellinus*** were found on bamboo that matched the description of the new species, which is herewith fully described and illustrated.

Material and Methods:

Fruitbodies were free-hand cut for microscopical study and sections were mounted in 5% KOH with 1% aqueous phloxine solution, Melzer's reagent (Singer, 1949), or lactophenol-cotton-blue. Colours are according to Villalobos-Domínguez & Villalobos (1947).

PHELLINUS SPINESCENS
Wright & Coelho sp. nov.

(Fig. 1)

Basidiocarpo *annuo, resupinato, tenuis, cinnamomeo ad ochraceo-brunneo, margine pallidiore, poris angulatis, 4 - 6 per mm.* ***Systema hypharum*** *dimiticum, hyphis skeletibus sine septae, parietibus incrassatis, 2 x 3.5 µm diam.; hyphis generativis tenuitunicatis, hyalinis vel pallide luteis, septatis, 2 - 4 µm diam.* ***Hymenium*** *cum setis ochraceo-ferrugineis, ventricosis, apicibus longis, saepe spinis subapicalibus praeditis, 27 - 51 x 7 - 10 µm; basidiis subglobosis vel cylindricis, 7 - 21 x 7 - 13 µm; cystidiis ventricosis, 12 - 32 x 5 - 9 µm; sporis subglobosis, dextrinoideis, crassitunicatis, 5.5 - 7 x 5 - 6 µm.* ***Holotypus****: Brasilia, Rio Grande do Sul, Santa Maria, Itaara, Parque Pinhal, Leg. G. Coelho, no. 29 - 9, 09.IX.1992, Ad culmos Bambusae (* ***ICN 97790; isotypus BAFC 33581****).*

Basidiocarp annual, resupinate, up to 14 x 2 cm, papyraceous to fragile, thin, ca 1 mm thick; margin paler than the hymenophore, light brown (O/14-7°), velutinous, ca 1 mm; pore surface cinnamon (O/9-4°), ferrugineous- brown (O/10-12°) to dark-brown (O/5-10°); pores polygonal towards the margin, elongated towards the center; when growth has been deficient there may be oblique pores; 4 - 6 per mm; context ferrugineous brown (O/11-12°), thin, firm, ca 0.5 mm thick; tube walls concolorous and continuous with context, ca 1 mm thick.

Hyphal system dimitic; skeletal hyphae from context with thickened walls, yellowish-brown to ferrugineous with KOH, septa rare, 2 - 3.5 μm diam., lumen scant, tortuous, irregularly compacted; generative hyphae from context hyaline to yellowish with KOH, thin-walled, simple-septate, rarely branched, 2 - 4 μm diam.; skeletal hyphae from trama yellowish to ferrugineous in KOH, 2 - 3 μm diam.; generative hyphae from trama hyaline in KOH, branched, thin walled, simple septate, 2 - 3 μm diam. **Hymenium** with characteristic, ventricose setae with a rather prolonged apex, and lateral, subapical, spiny processes, ferrugineous-brown in KOH, 27 - 51 x 7 - 10 μm; basidia subglobose to cylindric, short, 7 - 21 x 7 - 13 μm, with 4 sterigmata; cystidioles ventricose, 12 - 32 x 5 a 9 μm; basidiospores globose to subglobose, dextrinoid, acyanophilous, hyaline in KOH, thick-walled, 5.5 - 7 x 5 - 6 μm, guttulate when young.

Substrate: culms of half-rotten ***Bambusa*** sp.

Distribution: ARGENTINA: Misiones, Iguazú Nat'l Park, and BRAZIL, Rio Grande do Sul, Santa Maria.

Material studied:

ARGENTINA: Misiones, Iguazú Nat'l Park (material lost, notes by JEW); BRAZIL, Rio Grande do Sul, Santa Maria, Itaara, Parque Pinhal, leg. G. Coelho 09.IX.1992, 29-9 (**ICN 97790, HOLOTYPE**; **BAFC 33581**, **ISOTYPE**); Ibid., leg. G. Coelho, 5.X.1992 (**ICN 97791, 97792, 97793**), 06.IV.1993 (**97794, 97795**), 03.VI.1993 (**97796**), 3.X.1993 (**97797, 97798**).

Remarks:

Phellinus spinescens can be easily identified by the presence of dextrinoid, almost globose spores, rather long setae with lateral spiny processes, and by growing on bamboo. It is separated from the ***Phellinus punctatus-robustus*** complex (Gilbertson & Ryvarden, 1987), by the usually much shorter setae found in those species. Other species growing on bamboo differ by the following characters: ***P. uncinatus*** Rajchenb. (Rajchenberg, 1987 a) by the middle-sized uncinate setae; ***P. bambusarum*** (Rick) Larsen (Rick, 1907, 1960; Rajchenberg, 1987 b) by the smaller ventricose setae and ***P. bambusinus*** (Pat.) Pat. (Rajchenberg & Meijer, 1990, Ryvarden, 1983) by the smaller ventricose setae and non dextrinoid, ellipsoid to subglobose spores.

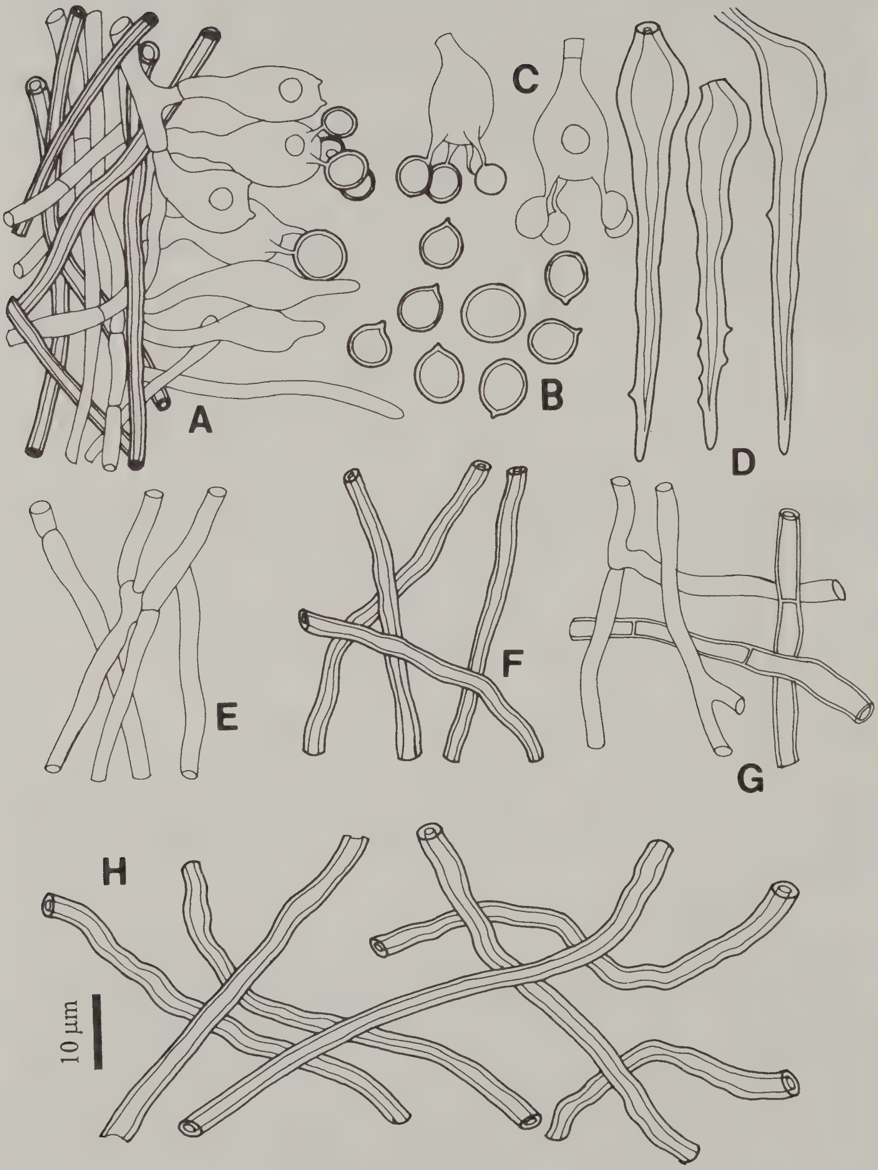

Figure 1.
A-Hymenium; **B**-Spores; **C**-Basidia; **D**-Hymenial setae; **E**-Tramal generative hyphae; **F**-Tramal skeletal hyphae; **G**-Contextual generative hyphae; **H**-Contextual skeletal hyphae.

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A NEW SPECIES OF *HYPOMYCES* AND THREE OF *CLADOBOTRYUM* FROM ESTONIA

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ABSTRACT

The teleomorph of the anamorphic species *Sibirina orthospora* was found for which a new pleomorphic species, *Hypomyces orthosporus*, is described. Because of the merging of *Sibirina* with *Cladobotryum*, the new combination *Cladobotryum orthosporum* is proposed for the anamorph. Three new species of *Cladobotryum, C. compactum, C. croceum* and *C. dimorphicum*, are described and illustrated from Estonia. Their preferable classification in one anamorphic genus is discussed.

Key words: fungicolous fungi, *Hypomyces, Cladobotryum, Sibirina, Hypocreaceae,* Aphyllophorales.

INTRODUCTION

Twenty species of *Hypomyces* (Ascomycotina, Hypocreales, Hypocreaceae) have been described growing on members of the Aphyllophorales (Rogerson and Samuels, 1993, 1995). Fourteen of them have a proven anamorph. In Europe so far only five species have been found with both morphs and three more as anamorphs. Besides these, ten anamorphic species related to *Hypomyces,* are known to inhabit Aphyllophorales fruitbodies (Arnold, 1969, 1987, 1988; Arnold & al., 1988; Castañeda-Ruiz, 1986, 1987; Gray & Morgan-Jones, 1980 a, b). They have been found in Cuba, North America or East Siberia and are mostly known only as single collections.

In autumn 1994 the teleomorph of a previously anamorphic species and three new anamorphic species occurring on fruitbodies of Aphyllophorales were found in Estonia (Eastern Europe, the northernmost of the three Baltic States).

Until recently a narrow generic concept was used for polyporicolous anamorphs of *Hypomyces* and related anamorphic taxa. Only a few years ago many of the type species of those small anamorphic genera have been merged in *Cladobotryum* (the oldest name available for that group), expanding it considerably (Rogerson & Samuels, 1993). So a choice must be made between these two concepts when describing new species in this complex of fungi.

MATERIAL AND METHODS

Descriptions of the species were made of colonies grown on 2% malt agar (MA) made of the broth from a brewery. Comparative studies were carried out on cornmeal agar (CMA, Difco), potato-carrot agar (PCA, 20 g carrots and 20 g potatoes boiled in 1 l water, 15 g agar added to the filtrate), potato-dextrose agar (PDA, Oxoid) and yeast-peptone-soluble starch agar (YPSS, Difco). Cultures were grown in darkness at about 24.5 °C. All the descriptions and illustrations of the species are based on cultures grown on MA unless otherways stated. Isolates from single ascospores or conidia were made with the help of a shortened (6 mm long, 0.3 mm diam.) hypodermic needle. Microscopic measurements were made in water. For scanning electron microscopy (SEM) specimens were prepared using the simplified technique presented by Samson, Stalpers & Verkerke (1979) with slight modifications.

Isolates obtained from the type specimens have been deposited in the Centraalbureau voor Schimmelcultures, Baarn.

DESCRIPTIONS OF THE SPECIES

Hypomyces orthosporus K. Põldmaa, *sp. nov.* (Fig. 1, 6, 7)

Subiculum effusum, pallidum, e hyphis ramosis, septatis, 3–5 μm crassis compositum. Perithecia globosa vel ovata, 240–360 × 140–320 μm, papillata, succinea, mollia, semiimmersa, solitaria vel aggregata. Asci cylindrici, 100–140 × 4–6 μm, octospori, apice paulum inspissato. Ascosporae fusiformes, 19–24 × 4–5 μm, aeque bicellulares, minute verrucosae, hyalinae, non apiculatae.

Holotypus: ad carposomata *Inonoti leporini* (Fr.) Gilb. & Ryvarden, Metsanurga, Distr. Läänemaa, Estonia, 26.09.1994, K. Põldmaa, TAA-161459 (Cult. 94-200).

Anamorph: **Cladobotryum orthosporum** (W. Gams) K. Põldmaa, *comb. nov.*
Basionym: *Sibirina orthospora* W. Gams, Persoonia 7: 163. 1973.

Subiculum effuse, whitish; hyphae branched, septate, 3–5 µm wide, KOH–. Perithecia globose to ovate, 240–360 × 140–320 µm, with a small and obtuse papilla, amber, soft, superficial or partly embedded in the subiculum, solitary to gregarious, KOH–. Asci cylindrical, 100–140 × 4–6 µm, with a slightly thickened apex; ascospores uniseriate with overlapping ends. Paraphyses absent. Ascospores fusiform, sometimes flattened from one side, straight, 19–24 × 4–5 µm, equally two-celled, sometimes slightly constricted at the septum, ends acute; finely verrucose, hyaline, apiculi not observed.

Colonies spreading rapidly, reaching 65 mm diameter in 7 days; floccose-cottony, partly fasciculate; whitish, turning yellow in some strains, reverse uncoloured or slightly ochraceous. Conidiation abundant. Odour absent. Aerial mycelium sparse; hyphae hyaline, 2–4 µm wide, smooth-walled. Conidiophores arising from aerial or submerged hyphae, without noticeable differentiation, ascending to suberect, 3–4 µm wide, branched irregularly or verticillately. Conidiogenous cells in terminal verticils or on short lateral branches, up to 16 in a cluster, in subterminal whorls 2–5; subulate, straight, 20–36 µm long, attenuated from 2–3 µm at the base to 0.8–1 µm at the tip; forming usually one, rarely up to three conidia from the terminal or occasionally also from one or two intercalary conidiogenous loci. Conidia cylindrical, sometimes slightly fusiform, mostly straight, 12–24 × 4–6 µm, two-celled, smooth-walled and hyaline, with a rounded tip and a basal hilum, lacking any wall thickening at the ends; when formed in succession joined at their bases in short imbricate chains. Chlamydospores subglobose, 8–12 µm in diameter or 10–14 × 9–11 µm, hyaline, smooth-walled; in chains or irregular sclerotioid aggregations among the aerial mycelium.

Conidial specimens examined: ESTONIA. Distr. Saaremaa, Viidumäe Nature Reserve, on *Daedalea quercina* Fr., 13.09.1993, leg. E. Parmasto, TAA-160997 (93-79); Distr. Tartumaa, Järvselja, on *Fomitopsis rosea* (Fr.) P. Karst., 02.09.1994, TAA-161252 (94-39); Distr. Läänemaa, Marimetsa bog, on *Phellinus chrysoloma* (Fr.) Donk, 24.09.1994, TAA-161401 (94-61). FINLAND. Etelä-Häme Prov., Ruissalo oak forest, on *Hymenochaete rubiginosa* (Fr.) Lév., 28.06.1994, TAA-161125 (94-6); Etelä-Häme Prov., Kotinen virgin forest, on *Phellinus viticola* (Schw.) Donk, 14.09.1994 TAA-161349 (94-39). All the specimens (except for the first one) were collected by K. Põldmaa.

Remarks.— Both stages of the fungus were found on the natural substrate. The anamorph appeared on the natural substratum as loose mycelium bearing conidiophores

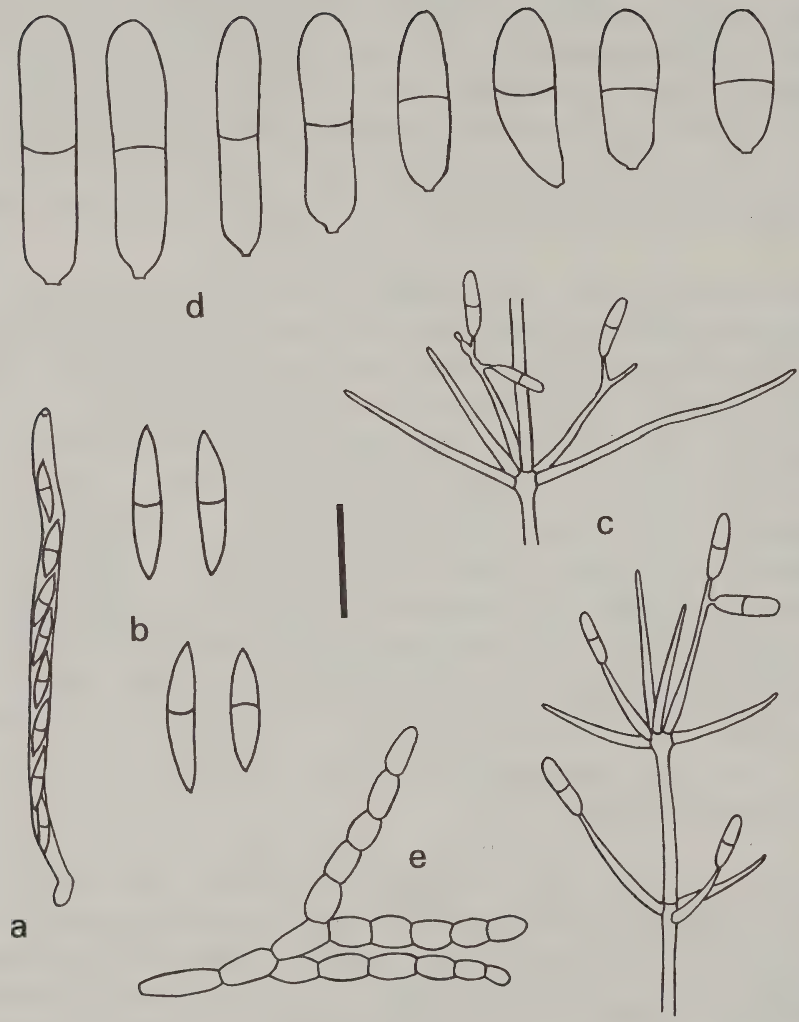

Fig. 1. *Hypomyces orthosporus*: a. an ascus; b. ascospores, c. conidiophores on YPSS, d. conidia on PDA, e. chlamydospores. Scale bar = 10 μm in b, d; 20 μm in a, c; 30 μm in e.

with typical two-celled and straight conidia near the perithecia. Most of the perithecia were juvenile with undifferentiated contents. Efforts to get ripe asci with ascospores using a moist chamber failed. Only in a few partly mature perithecia smooth-walled and non-apiculate ascospores were found in the asci (Fig. 1, a, b). All single-ascospore isolates formed the anamorph in culture. Isolates were also made from mass of ascospores and conidia. No perithecia were formed if the monospore isolates were paired in all possible combinations on OA, neither in the polysporic isolates on MA.

Until recently only four conidial isolates of this fungus were described in litereraturе (Gams, 1973; Helfer, 1991). While studying ascosporic as well as the listed conidial isolates of *Hypomyces orthosporus*, some undescribed features were observed. The most important of these is the occurrence of intercalary conidiogenous loci. Their frequency seems to depend on the strain and less on the growth medium. They formed more abundantly in the strain 94-61 and seemed to be favoured by YPSS agar (Fig. 1, c). On the other hand, the formation of more than one conidium from the terminal locus appeared to be quite rare. In this respect the species is similar to *Sibirina gamsii* D.J. Gray & Morgan-Jones. In the type isolate, CBS 598.88, intercalary conidiogenous loci were found, although in the original description conidiogenous cells were said to be monophialidic.

It was noticed that in some old strains of *H. orthosporus* the cultures turned yellow (as characteristic of *H. semitranslucens* G. Arnold) and a few ones showed a very pale violet tinge already from the early stages of colony development. Also the presence of chlamydospores (Fig. 1, e) and the formation of sclerotioid aggregations, seen in some ascosporic isolates, have not been described before. For the more frequent *H. semitranslucens* G. Arnold such structures have been depicted only by Arnold (1970), to which the present fungus is very similar in both of its morphs, differing mainly by the lack of odour in culture and the more slender and straight conidia without wall-thickening at the ends (Fig. 1, d). The lack of verrucae and apiculi on the ascospores cannot be used as differentiating characters as the spores in the type specimen are probably immature. In some strains of *H. orthosporus* the yellow pigment and fusiform unilaterally flattened conidia, characteristic of *H. semitranslucens*, occurred. So the question about the relation between the two taxa is left for further investigations.

Cladobotryum compactum K. Põldmaa, *sp. nov.* (Fig. 2, 8, 9)

Coloniae ad 25 mm diam. post 7 dies; velutinae, albae vel cremeae, reverso ochraceo. Hyphae aeriae hyalinae, 3–5 μm latae. Conidiophora plusminusve erecta, 4–6 μm lata, irregulariter ramosa. Cellulae conidiogenae in ultimo verticillo ad 8, subulatae, 24–52 μm longae, prope basin 2.5–3 μm latae; ex uno loco ad 12 conidia producunt. Conidia ellipsoidea usque ad cylindrica vel clavata, recta, unicellularia 7–9 × 3–5 μm, bicellularia 10–15 μm longa, levia, hyalina, apice rotundata, basi apiculata, catenis imbricatis cohaerentia. Chlamydosporae globosae, 9–13 μm diam., catenis brevibus cohaerentia.

Holotypus: ad carposomata *Steccherini ochracei* (Fr.) Gray, Lääniste, Tartumaa, Estonia, 28.08.1994, K. Põldmaa, TAA-161231a (Cult. 94-64).

Colonies spreading moderately, reaching 25 mm in diameter in 7 days; velvety, with a compact central area and a looser margin; white to cream-coloured, sometimes with straw-yellow or apricot tinges in the central part (especially on PDA), reverse pale ochraceous. Conidiation abundant. Odour absent. Aerial mycelium quite scarse and low; hyphae hyaline, 3–5 μm wide, smooth-walled. Conidiophores arising from submerged or aerial hyphae, suberect to erect, straight, up to 280 μm high, 4–6 μm wide at the base, unbranched or irregularly branched. Conidiogenous cells in terminal or subterminal verticils of up to 8 (mostly 4–6), seldom on short lateral branches; subulate, straight, 24–52 μm long, attenuated from 2.5–3 μm at the base to 1–2.5 μm at the tip; arising also singly from aerial hyphae, then being up to 240 μm long; sometimes with one or two septa in the central part; forming up to 12 (usually to 5) conidia from the terminal conidiogenous locus. Conidia ellipsoid to cylindrical or clavate, straight, one-celled 7–9 × 3–5 μm or two-celled 10–15 × 4–6 μm, smooth-walled, hyaline, mostly with a rounded tip and a conspicuous and often laterally displaced basal hilum (less pronounced in one-celled conidia); produced asymmetrically at the tips of conidiogenous cells and joined at their bases in imbricate chains. Chlamydospores subglobose, 9–13 μm in diameter or 12.5–16 × 10–12 μm, hyaline, smooth-walled, formed singly or more often in short chains just above the surface of the agar medium.

Remarks.— The fungus forms loose tufts of mycelium bearing erect conidiophores with conidia on the hymenium of the host's carpophores. The morphology and measurements of the microscopic structures are similar to those observed in pure culture.

The isolate shows much similarity to *Cladobotryum pinarense* Castañeda (Castañeda, 1986). Comparison of the type isolate, CBS 406.86, with that of *Cladobotryum compactum* on CMA, MA, PCA and PDA showed that both formed conidia in long imbricate chains on verticillately disposed conidiogenous cells. The morphology of the conidia and the process of conidiation are very similar too. The first formed two-celled conidia are more slender and clavate with a conspicuous basal hilum, while subsequent ones become ellipsoid, lack the septum and the basal hilum is not so conspicuous (Fig. 2, c, d; 9). Because conidiogenous cells with obtuse tips become more abundant in older cultures they can be considered to be retrogressive as described for *Trichothecium roseum* (Kendrick & Cole, 1969) and *Cladobotryum varium* (Cole & Kendrick, 1971) and inferred for *Hypomyces subiculosus* (Berk. & M.A. Curt.) Höhnel according to the description of the synonymous *H. trichothecioides* Tub. by Tubaki (1960). The measurements of the conidia and conidiogenous cells are almost the same although those

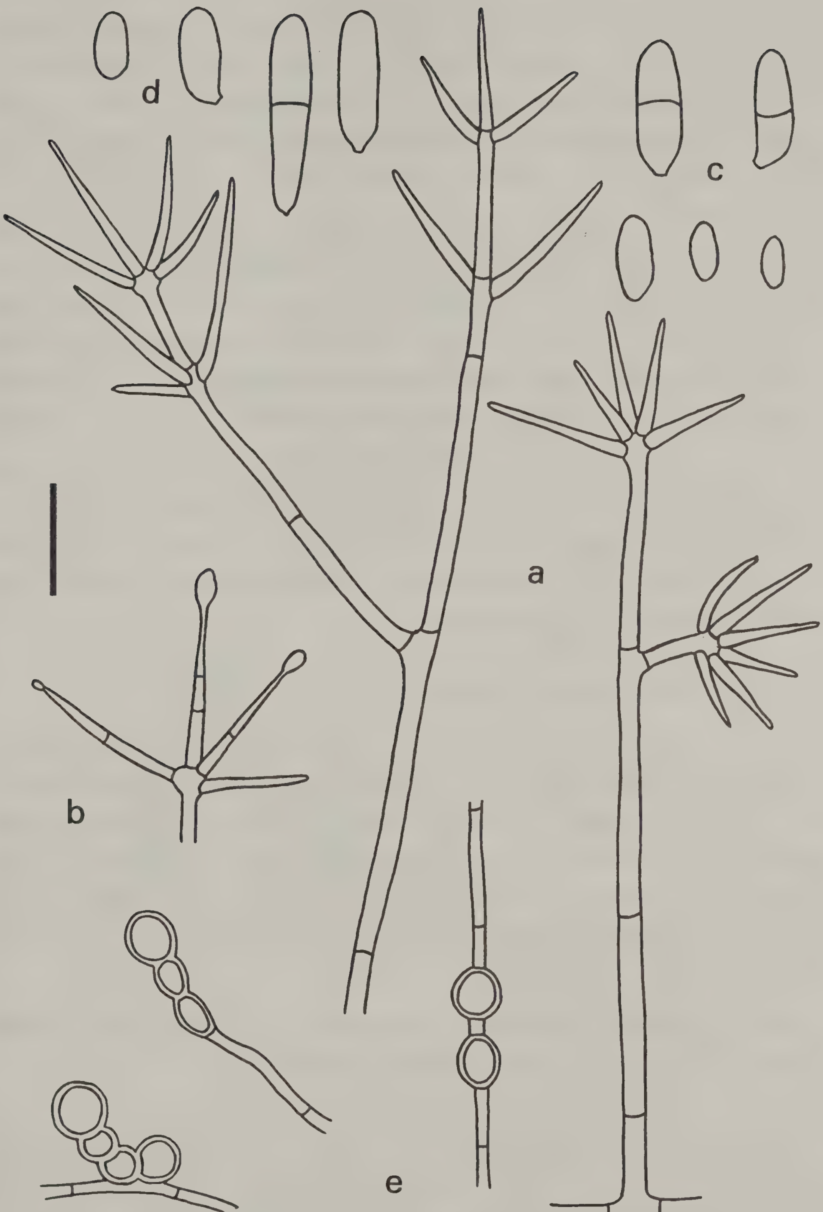

Fig. 2. *Cladobotryum compactum*: a. conidiophores, b. a cluster of conidiogenous cells, c. conidia, d. conidia on PCA, e. chlamydospores. Scale bar = 10 μm in c, d; 20 μm in a, b, e.

originally observed in *C. pinarense* were much smaller.

Independent of the medium used, there are some more or less constant and strain-specific differences in several character states, mainly features of the colony. *C. compactum* grows much more slowly, it is very compact and low and has quite an irregular margin compared with *C. pinarense*. The pigmentation is completely different and *C. compactum* also lacks the distinctive agaric-like odour, which is very characteristic of *C. pinarense*.

Unlike *C. compactum*, conidiophores of *C. pinarense* are ascending and not much differentiated from aerial hyphae and the number of conidiogenous cells in the terminal verticil is mostly four with their disposition being more penicillate. Because of the penicillate and more profuse branching in the upper part of the conidiophore, conidial chains tend to adhere together forming large conidial aggregations. In *C. pinarense* conidia are not so clearly dimorphic. They are mostly clavate and two-celled and measure 11–17.5 × 5–6 μm on MA. Chlamydospores are lacking.

According to the conidial morphology and development, *C. compactum* shows similarity also to the anamorph of *Hypomyces subiculosus*, to *Cladobotryum penicillatum* W. Gams (Gams, 1980) and *Cladobotryum odorum* G. Arnold (Arnold, 1988). Comparison of the culture of the last-mentioned species is needed in view of its quite probable conspecifity with *C. pinarense*.

Cladobotryum croceum K. Põldmaa, *sp. nov.* (Fig. 3, 10)

Coloniae ad 50 mm diam. post 7 dies; floccosae–lanosae, flavae, reverso flavo vel croceo. Hyphae aeriae hyalinae, 3–5 μm latae. Conidiophora adscendentia vel fere erecta, 4–5 μm lata, irregulariter vel verticillatim ramosa. Cellulae conidiogenae in ultimo verticillo ad 12, subulatae, 20–36 μm longae, prope basin 2–2.5 μm latae; ex uno loco ad tria conidia producentia. Conidia fusiformia, recta, 12–20 × 4–5.5 μm, bicellularia, levia, hyalina, apice acuta, basi apiculata; catenis brevibus adhaerentia. Chlamydosporae globosae, 8–25 diam., catenis brevibus vel aggregatis irregularibus dispositae.

Holotypus: ad carposomata *Sterei rugosi* (Fr.) Fr., Parasmaa, Distr. Pärnumaa, Estonia, 25.09.1994, K. Põldmaa, TAA-161418 (Cult. 94-67).

Colonies spreading rapidly, reaching 50 mm diameter in 7 days; floccose–cottony, partly fasciculate; at first pale yellow, later turning deep to orange-yellow (especially on PDA), reverse bright yellow to orange-yellow, sometimes turning brown. Conidiation abundant. Odour absent. Aerial mycelium sparse and low; hyphae hyaline, 3–5 μm wide, smooth-walled. Conidiophores arising from aerial or submerged hyphae, without noticeable differentiation, ascending to suberect,

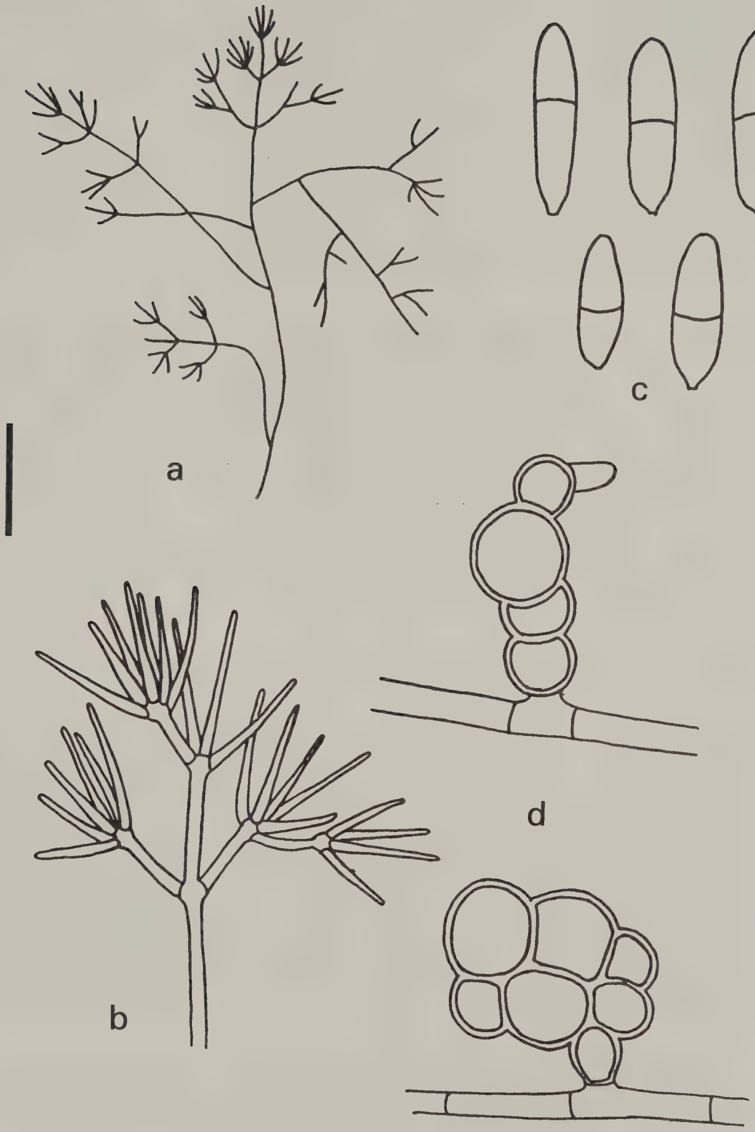

Fig. 3. *Cladobotryum croceum*: a. branching pattern of a conidiophore, b. part of a conidiophore, c. conidia, d. chlamydospores. Scale bar = 10 μm in c, d; 20 μm in b; 100 μm in a.

4–5 μm wide, branched irregularly or verticillately. Conidiogenous cells in terminal verticils or on short lateral branches, up to 12 (18 on PCA) in a cluster, in subterminal whorls 2 to 5; subulate, straight, 20–36 μm long, attenuated from 2–2.5 μm at the base to 0.8–1 μm at the tip; forming up to 3 (–5) conidia from the terminal conidiogenous locus. Conidia ellipsoid to fusiform, straight, 12–20 × 4–5.5 μm, two-celled, smooth-walled and hyaline, attenuated at both ends (sometimes with a rounded tip), with a basal hilum, lacking any wall thickening at the ends; joined at the bases in short imbricate chains. Chlamydospores globose, 8–25 μm in diameter, subhyaline or brownish, smooth-walled; formed in chains or irregular clusters on short lateral branches in the agar medium or just above its surface.

Remarks.— Erect conidiophores arising from loose mycelium could be seen only on old parts of host's carpophore, also on a small twig which grows through it and mosses (*Aulacomnium androgynum*) nearby. The morphology and measurements of the microscopic structures are similar to those observed in pure culture. While examining the fungus in Petri dish cultures under the stereo microscope and also with the SEM, conidia are often seen to be attached with the tip to the central part of the older one (Fig. 10).

C. croceum is similar to other species formerly grouped in *Sibirina,* differing from them by the characteristic orange-yellow pigment and the frequent multiple formation of conidia which are attenuated at both ends (Fig. 3, c).

Cladobotryum dimorphicum K. Põldmaa, *sp. nov.* (Fig. 4, 5, 11, 12)

Coloniae ad 20 mm diam. post 7 dies, velutinae, albae vel cremeae, reverso rufobrunneo. Mycelium fere submersum, hyphae saepe inflatae, hyalinae vel brunneae; hyphae aeriae hyalinae, 3–5 μm latae. Conidiophora dimorphica, adscendentia 3–5 μm lata, erecta 6–10 μm lata, irregulariter vel verticillatim ramosa. Cellulae conidiogenae in ultimo verticillo ad 3, subulatae, 28–60 μm longae, prope basin 2–4 μm latae; ex uno loco ad 10 conidia producentia. Conidia ellipsoidea usque ad clavata, recta, uni- ad quadricellularia, 6–28 × 4–10 μm, levia, hyalina, apice rotundata, basi apiculata, catenis imbricatis adhaerentia. Chlamydosporae globosae, 9-14 μm diam., catenis vel aggregatis irregularibus dispositae.

Holotypus: ad carposomata *Thelephorae terrestris* Fr., Palivere, Distr. Pärnumaa, Estonia, 24.09.1994, K. Põldmaa, TAA-161405 (Cult. 94-76).

Colonies spreading moderately, reaching 20 mm diameter in 7 days; velvety, compact in the central area and more loose and fasciculate at the margin; white to cream-coloured, becoming brownish in age, reverse turning locally dark reddish-brown under

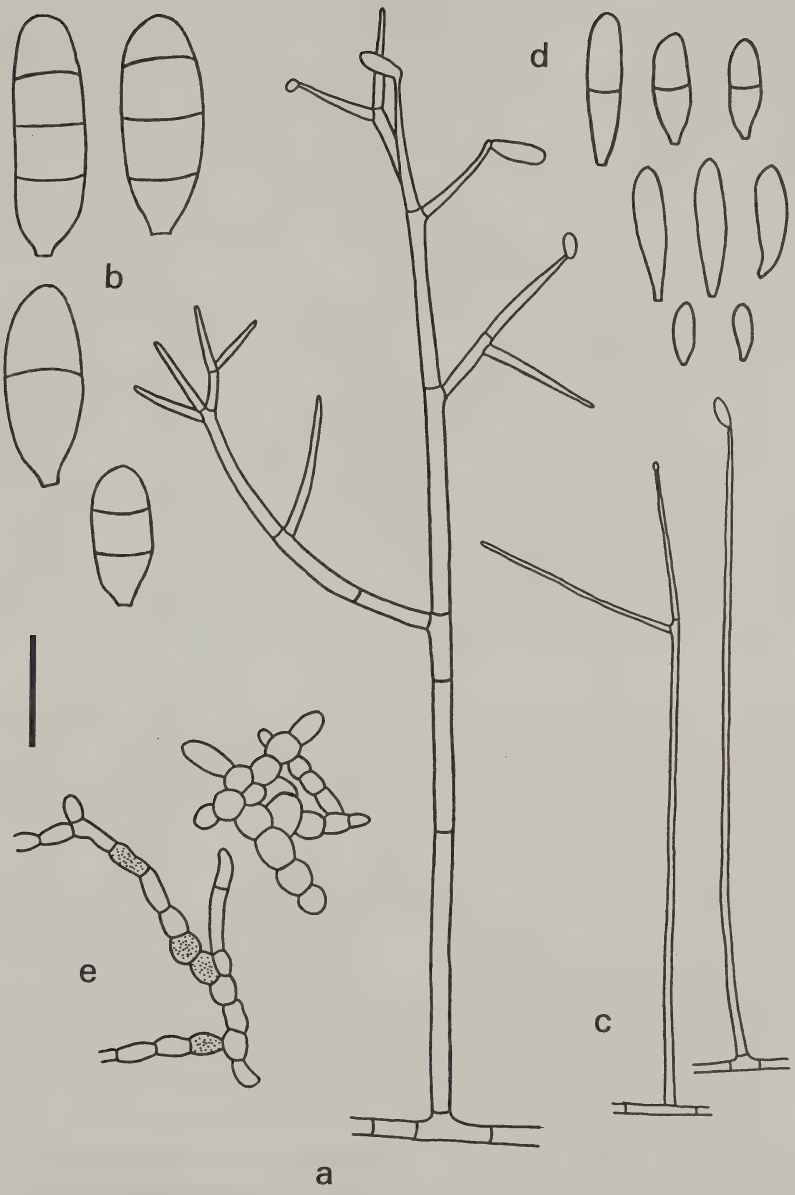

Fig. 4. *Cladobotryum dimorphicum*: a. a wide and thick-walled conidiophore, b. conidia from it, c. slender and simple conidiophores from the margin of the colony, d. conidia from them, e. chlamydospores. Scale bar = 10 μm in b, d; 30 μm in a, c, e.

the compact central area. Conidiation abundant. Odour absent. Mycelium mostly submerged; hyphae hyaline to brown, composed mainly of swollen cells, 5-7.5 μm wide, branching locally profusely with the formation of dense patches. Aerial mycelium scarse and low; hyphae hyaline, 3–5 μm wide, smooth-walled. Conidiophores of two types, (a) arising from the aerial mycelium, hardly differentiated, ascending to suberect, straight or flexuous, (b) arising from the aerial mycelium or from the slender conidiophores, often in clusters, markedly differentiated in width and wall thickness, suberect to erect, up to 375 μm long, 6–10 μm wide at the base, with up to 10 septa; both types irregularly or verticillately branched. Conidiogenous cells in terminal or subterminal verticils or on lateral branches of up to 3 (–4), subulate, straight, 28–60 μm long, attenuated from 2–4 μm wide at the base to 1–2 μm at the tip; or arising singly from the aerial hyphae, then being up to 500 μm long; forming up to 10 conidia from the terminal conidiogenous locus or seldom 1–4 conidia from an intercalary outgrowth which is left after the main axis turns aside and continues to grow. Conidia ellipsoid to clavate or obovoid, straight, 5–28 × 4–10 μm, one- to four-celled, smooth-walled, hyaline, with a rounded tip and a conspicuous, often laterally displaced basal hilum; produced asymmetrically at the tips of conidiogenous cells and joined at their bases in imbricate chains. Chlamydospores abundant, subglobose, 9–14 μm in diameter, subhyaline to brown, smooth-walled; in chains which may branch, or forming very big irregular clusters in the agar medium.

Remarks.— On the hymenophore of the natural substratum the fungus forms a dense creamish-ochraceous mycelial mat which bears erect and straight conidiophores with two- to four-celled conidia (14–24 × 7–8 μm). In order to study the dimorphism of the conidial apparatus, several isolates from single conidia were made. Independently of the septation and the size of the conidia used, similar cultures were obtained.

The multicellular conidia germinate within a day mostly from one or both apical cells, seldom also from the central ones. Cells of the developing submerged hyphae become swollen, especially at the nodes. Patches of very compact submerged mycelium are formed due to the profuse branching of hyphae in some places.

Sporulation begins on the fourth or fifth day. At first slender conidiophores, not differentiated from the aerial hyphae are prevailing. Their branching is usually profuse (Fig. 5, a), but in some subcultures simple and very long cells bearing a cluster of conidia are formed (Fig. 4, c). Soon more thick, straight and less branched conidiophores (Fig. 4, a) begin to develop and overgrow the previous ones. The conidiogenous cells are presumed to develop retrogressively because of the increased appearance of broadly truncate tips with age. Slender conidiophores are sometimes seen to proliferate

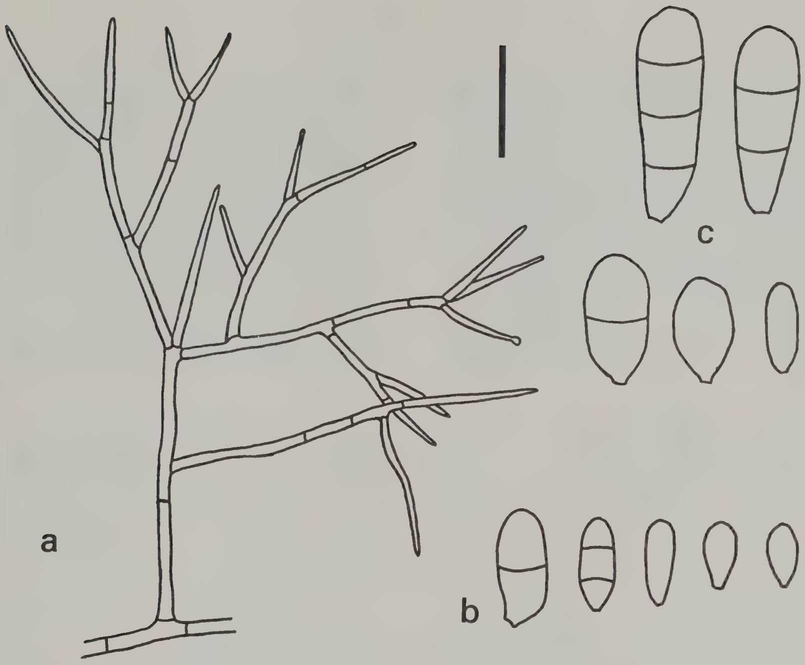

Fig. 5. *Cladobotryum dimorphicum* on PDA: a. a slender and profusely branched conidiophore, b. conidia from it, c. conidia from wide conidiophores. Scale bar = 10 μm in b, c; 30 μm in a.

sympodially after the formation of a first conidial cluster[1]. Clavate or obovoid conidia occur on both types of conidiophores, but on the slender conidiophores they are much smaller and mainly one- or two-celled (Fig. 4, d; 5, b).

On the sixth day part of the submerged mycelium turns yellowish-reddish-brown. Some scattered cells become pigmented beginning from the central area. The pigment diffuses also into the medium beyond the colony. The cells of the submerged hyphae become more and more rounded, and within two weeks most of the mycelium has developed into chlamydospores (Fig. 4, e). The growth pattern of *C. dimorphicum* is very irregular, leading to asymmetrical colonies in most subcultures.

Some of the characters are influenced by the medium used. On PDA colonies are more compact and the branching of the slender conidiophores is more profuse. On PCA, OA and CMA growth is very restricted, the colonies not exceeding 20 mm in diameter and the reverse of the agar turning only slightly brownish.

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[1] According to this character, *C. dimorphicum* could have been described as belonging to *Arnoldiomyces, Pseudohansfordia* or *Sympodiophora.*

This species shows great similarity to the anamorph of *Hypomyces polyporinus* Peck, first of all due to the characters of their colonies and conidiogenous cells. The following comparison is based on the description of the anamorph of *H. polyporinus* by Carey and Rogerson (1981) and a culture, CBS 168.89. Colonies of both species are quite compact and low, forming dense submerged mycelium and diffusing brownish pigment. In both species conidiogenous cells are retrogressive, capable also of sympodial growth. Conidia are one- to four-celled and adhere obliquely in imbricate chains.

Still there are many differences distinguishing these two species. In *H. polyporinus* the colonies are pure white, the diffusing pigment is brick and the margin is even. The conidiophores are all uniform and not well differentiated, the conidiogenous cells being much longer and not in whorls. Conidia are mostly longer and more slender than those of *C. dimorphicum.* In the latter species 4-celled, but in *H. polyporinus* 3-celled conidia are dominating. One of the main differences is the occurrence of chlamydospores. Contrasting with the abundant brown chlamydospores of *C. dimorphicum,* in *H. polyporinus* they are rare, without pigmentation and few-celled.

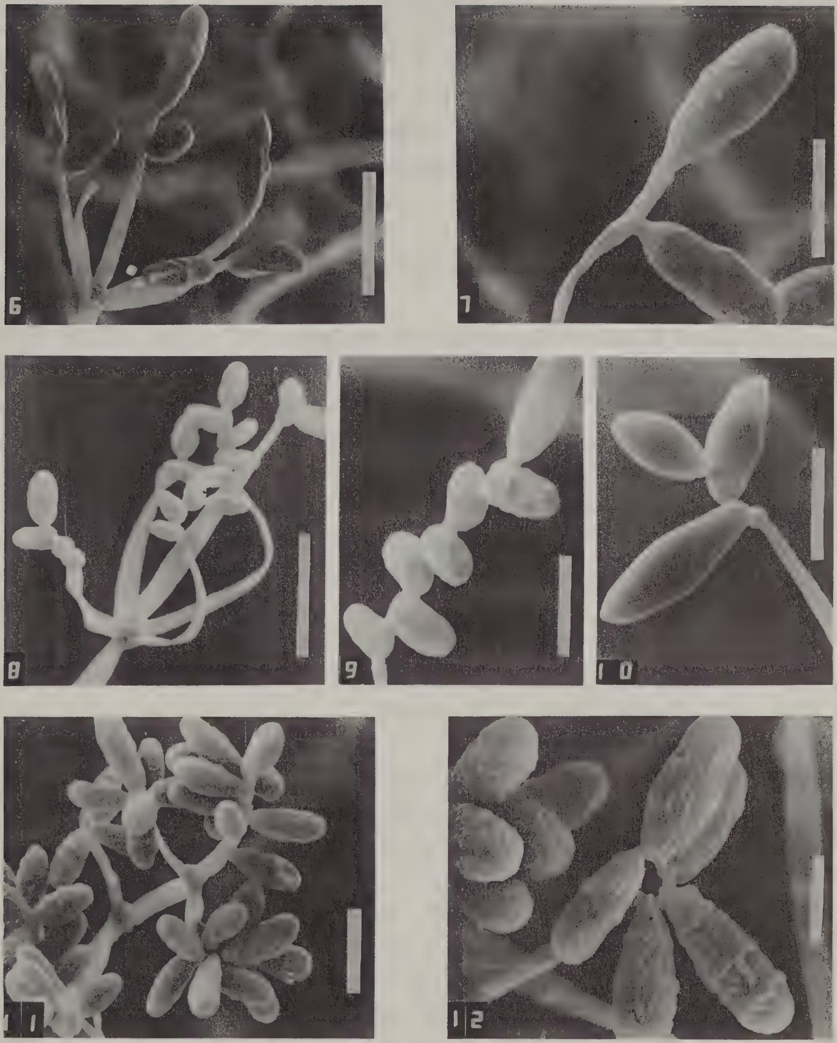
Differences can also be seen in the growth rates on different media. On CMA *H. polyporinus* grows two times faster than *C. dimorphicum.* On PDA the situation is just the opposite.

DISCUSSION

Almost all of the proven anamorphs of polyporicolous *Hypomyces* species previously distributed over several different anamorphic genera have been recently merged in *Cladobotryum* by Rogerson and Samuels (1993), who expanded the genus concept widely.

The anamorphs characterised by the disposition of conidiogenous cells in dense verticils had been placed in the anamorphic genus *Sibirina* G. Arnold, but previous authors (de Hoog, 1978; Gams, 1983) already suggested that its retention may not be justified. When a separate genus is required for species with dense verticils of conidiogenous cells, *Sibirina* would have to be broadened so as to include species with multiple conidial formation, the existance of more than one conidiogenous locus on one conidiogenous cell, and the presence of one- to four-celled conidia. Because of the ensuing lack of characters differentiating such anamorphs from *Cladobotryum* and the close phylogenetic relationships of the teleomorphs, this idea cannot be supported.

At present characters other than morphological are lacking for most of the anamorphs connected with *Hypomyces*. The pigment analyses, carried out with 20 species (Helfer,



Figs. 6-12. SEM photos showing the conidiogenous cells with conidia of the described species. Figs. 6,7. *Hypomyces orthosporus*, conidiogenous cells with more than one conidiogenous locus. Figs. 8,9. *Cladobotryum compactum*. Fig. 10. *C. croceum*. Figs. 11, 12. *C. dimorphicum*, conidiogenous cells with conidia from the wide and thick-walled conidiophores. Scale bars = 10 μm in 7, 9, 10, 12; 20 μm in 6, 8, 11.

1991), did not support grouping of anamorphs according to the mode of conidiogenesis. I agree with Gams (1995) in the idea of not lumping together all widely differing anamorphs associated with one teleomorph-genus into one genus, at least for practical purposes. But in this complex of fungi "criteria used for identification which should clearly favour splitting" (Gams, 1995) are not unequivocally established. Therefore the expanded generic concept advocated by Rogerson & Samuels (1993) is adopted here to include the described species and the anamorph of *Hypomyces orthosporus* in this broad genus.

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I am indebted to Prof. Walter Gams (Centraalbureau voor Schimmelcultures, Baarn, the Netherlands) for many valuable comments during the preparation and also for the final critical revision of the manuscript, as well for obtaining several isolates from the CBS. My thanks also to Prof. Erast Parmasto (Institute of Zoology and Botany, Tartu, Estonia) who determined the Aphyllophorales species and to Mart Rahi (from the same institute) for the great help in working with the SEM.

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NEW SPECIES IN THE LICHEN FAMILY PARMELIACEAE (ASCOMYCOTINA) FROM AUSTRALASIA AND OCEANIA

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ABSTRACT : The following new lichen species are described, *Neofuscelia remnantia* Elix, *Paraparmelia bourgeanica* Elix, *Paraparmelia inconspicua* Elix, *Paraparmelia inselbergia* Elix, *Paraparmelia lumbschii* Elix and *Xanthoparmelia norstrigosa* Elix from Australia; *Myelochroa nothofagi* Elix from Papua New Guinea and *Parmotrema tongaense* Elix from Tonga.

Introduction

As a result of further study of the lichen family Parmeliaceae in Australasia and Oceania (Elix 1994, 1995), I am describing 8 new species. Throughout the present work chemical constituents were identified by thin layer chromatography (Culberson 1972; Culberson, Culberson & Johnson 1981; Culberson & Johnson 1982; Elix & Ernst-Russell 1993; Elix et al. 1988), high performance liquid chromatography (Feige et al. 1993) and comparison with authentic samples.

Neofuscelia remnantia Elix, sp. nov. Fig. 1

Species cum thallo ut in *Neofuscelia imitatricoide* sed ab hac specie thallo multo parviore, lobis angustioribus et isidiatis differt.

Type: Australia. Western Australia. Yilliminning Rock, 18 km NE of Narrogin, 32°57'S, 117°22'E, 320 m, on large exposed granite outcrop, *J. A. Elix 41058b, H. T. Lumbsch & H. Streimann,* 12.ix.1994; holo: CANB.

Thallus minutely foliose to subcrustose, saxicolous, adnate to moderately adnate, 0.5-0.7 cm wide. *Lobes* separate, sublinear, dichotomously to irregularly branched, 0.1-0.3 (-0.5) mm wide. *Upper surface* reddish brown to black-brown, convex, slightly shiny at the lobe apices, becoming rugose and cracked with age, sparsely isidiate towards the centre; isidia globose, simple, with syncorticate, intact apices. Medulla white. *Lower surface* black to brown-black; rhizines sparse, black, simple, robust. *Pycnidia* and *apothecia* not seen.

Chemistry. Cortex K-, HNO_3+ dark blue-green, medulla K-, C-, P-; containing 4-*O*-methylphysodic acid (major), α-collatolic acid (trace), physodic acid (trace).

The only other species of *Neofuscelia* known to produce 4-*O*-methylphysodic acid as the major medullary constituent is *N. imitatricoides* Elix, a lichen with a much larger, obviously foliose, thallus (3-4 *cf.* 0.5-0.7 cm wide) with broader lobes (0.6-1.2 *cf.* 0.1-0.5 mm wide) which lack isidia. In gross morphology *N. remnantia* resembles *N. minuta* (Essl.) Essl., since both species have small subcrustose thalli with very narrow lobes. However, the thallus of *N. minuta* is tightly adnate with crowded lobes and contains gyrophoric acid, while *N. remnantia* is only moderately adnate to adnate, with separate lobes and contains 4-*O*-methylphysodic acid. Whereas *N. minuta* develops small irregular papillae and lobulae towards the centre of the thallus, the older lobes of *N. remnantia* develop sparse globose isidia. At present *N. remnantia* is only known from the type locality.

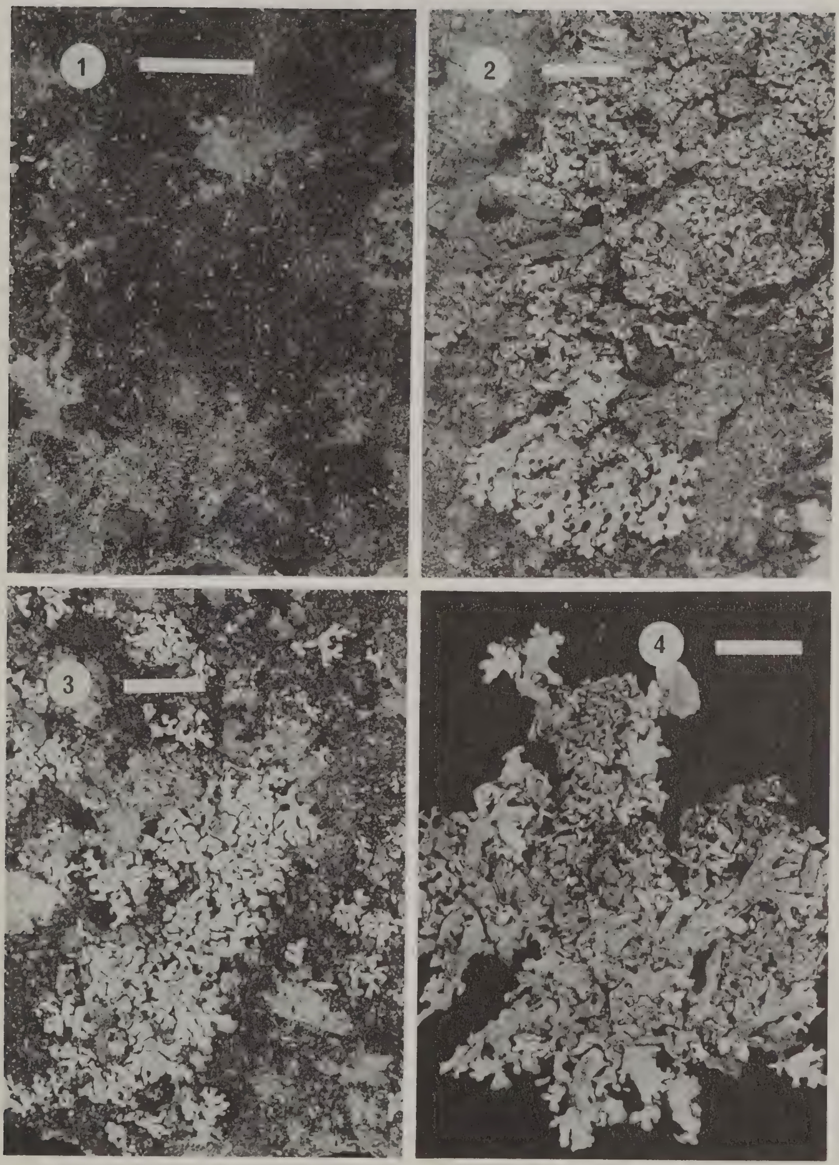
Myelochroa nothofagi Elix, sp. nov. Fig. 2

Species cum thallo ut in *Myelochroa leucotyliza* sed ab hac specie thallo parviore, lobis angustioribus et 6α,16β-diacetoxyhopane-22-olo et 16β-acetoxyhopane-6α,22-diolo maximis continente differt.

Type: Papua New Guinea. Southern Highlands Province. Andawe River, Lama sawmill logging area, 6 km SE of Ialibu, 6°20'S, 144°01'E, 1840 m, on canopy branches of *Nothofagus* in *Nothofagus-Podocarpus* forest, *J. A. Elix 12760 & H. Streimann*, 11.xii.1982; holo: CANB.

Thallus corticolous, adnate, 5-6 cm wide. *Lobes* imbricate, sublinear, dichotomously to subirregularly branched, 0.2-0.8 (-1.0) mm wide; the margin ciliate; cilia simple, dense, regularly dispersed, 0.2-0.4 mm long. *Upper surface* pale mineral grey to grey-green, flat, shiny, white-maculate, lacking isidia, sparsely to moderately pustulate; pustules breaking open and coalescing but not becoming sorediate. Medulla pale yellow throughout. *Lower surface* black; rhizines dense, black, simple to sparsely squarrosely branched. *Pycnidia* and *apothecia* not seen.

Chemistry. Cortex K+ yellow, medulla K-, C-, P-; containing atranorin, zeorin (major), 6α,16β-diacetoxyhopane-22-ol (major), 16β-acetoxyhopane-6α,22-diol (major), secalonic acid A (major), 6α-acetoxyhopane-16β,22-diol (trace), leucotylin (trace), unknowns (trace).



Figures 1-4. New species of Parmeliaceae: 1, *Neofuscelia remnantia* (holotype in CANB); 2, *Myelochroa nothofagi* (holotype in CANB); 3, *Paraparmelia bourgeanica* (holotype in CANB); 4, *Paraparmelia inconspicua* (holotype in CANB). Scale bar = 5mm.

This new species resembles *Myelochroa leucotyliza* (Nyl.) Elix & Hale in that both produce pustules which do not become sorediate, have a pigmented medulla and, in part, have analogous medullary chemistry. Whereas *M. nothofagi* has a small thallus with very narrow lobes, *M. leucotyliza* has a larger thallus (8-12 cm *cf.* 5-6 cm wide) with broader lobes (2-4 mm *cf.* 0.2-1.0 mm wide). In addition these two species differ in their medullary triterpene profiles, which are so characteristic of this genus. Thus *M. leucotyliza* contains zeorin and leucotylin as major triterpenes whereas *M. nothofagi* contains significant quantities of zeorin, 6α,16β-diacetoxyhopane-22-ol, 16β-acetoxyhopane-6α,22-diol. At present *M. nothofagi* is only known from the type collection from the Southern Highlands of Papua New Guinea, while *M. leucotyliza* is common in Japan.

Paraparmelia bourgeanica Elix, sp. nov. Fig. 3

Species cum thallo ut in *Paraparmelia sargentii* sed ab hac specie acido bourgeanico continente differt.

Type: Australia. Western Australia. Slopes of Angwin Peak, Porongurups Range, Porongurups National Park, 19 km ESE of Mt Barker, 34°40'S, 117°51'E, 360 m, on granite rocks, *J. A. Elix 41319, H. T. Lumbsch & H. Streimann*, 17.ix.1994; holo: CANB.

Thallus small-foliose to subcrustose, adnate, saxicolous, forming irregular rosettes to 1.5 cm wide. *Lobes* rarely imbricate, radiating at the apices, sublinear, subdichotomously branched, 0.3-0.6 (-1.0) mm wide. *Upper surface* pale ash-grey, black-marginate towards the lobe apices, flat, smooth and shiny at the tips, becoming dull within, emaculate, developing dense granular pruina subapically, lacking soredia and isidia; older lobes becoming rugose and areolate. Medulla white. *Lower surface* pale tan to brown, darker towards the apices; rhizines sparse, simple, thick, to 0.2 mm long, concolorous. *Pycnidia* and *apothecia* not seen.

Chemistry. Cortex K+ yellow; medulla K-, C-, P-; containing usnic acid, bourgeanic acid (major), conbourgeanic acid (minor).

This species is characterized by the formation of tiny rosettes with pale ash-grey, narrow (0.3-1.0 mm wide), linear, radiating lobes, the pale lower surface and the production of fatty acids in the medulla. *Paraparmelia sargentii* Elix & J.Johnst. exhibits similar morphological features, but differs in containing constipatic and protoconstipatic acids in the medulla. At present this species is only known from the type location.

Specimens Examined
WESTERN AUSTRALIA. Type locality, *J. A. Elix 41312, H. T. Lumbsch & H. Streimann*, 17.ix.1994 (CANB, HO).

Paraparmelia inconspicua Elix, sp. nov. Fig. 4

Species cum thallo ut in *Paraparmelia subtropica* sed ab hac specie laxe adnato, isidiis globosis et acido hypostictico et acido hyposalazinico noncontinente differt.

Type: Australia. Western Australia. Slopes of Angwin Peak, Porongurups Range, Porongurups National Park, 19 km ESE of Mt Barker, 34°40'S, 117°51'E, 360 m, on granite rocks, *J. A. Elix 41347, H. T. Lumbsch & H. Streimann*, 17.ix.1994; holo: CANB.

Thallus small-foliose, moderately to loosely adnate, saxicolous, forming irregular rosettes to 2 cm wide. *Lobes* imbricate, irregular to sublinear, irregularly to subdichotomously branched, 0.2-1.0 mm wide. *Upper surface* pale ash-grey, black-marginate towards the lobe apices, flat, smooth and shiny at the tips, becoming dull and blackening in the thallus centre, isidiate; isidia sparse to dense, globose then short cylindrical, simple or very rarely branched; isidia apices syncorticate, intact. Medulla white. *Lower surface* black, brown at the apices; rhizines sparse, robust, simple or tufted, black. *Apothecia* rare, subpedicellate, to 2 mm wide; disc shallowly concave to ±flat, mid-brown; thalline exciple thin, isidiate. Ascospores ellipsoid, 7-11 x 3.5-5.5 µm. *Pycnidia* not seen.

Chemistry. Cortex K+ yellow, medulla K+ yellow becoming red, C-, P+ orange; containing atranorin, norstictic acid (major), connorstictic acid (minor/trace).

Like *Paraparmelia subtropica* Elix & J. Johnst. this new species is characterized by the small foliose thalli, the black lower surface, the presence of isidia and medullary norstictic and connorstictic acids. However, these two species differ in the adnation of the thalli, the nature of the isidia and minor medullary metabolites. Thus the thalli are tightly adnate in *P. subtropica* but moderately to loosely adnate in *P. inconspicua.* The isidia in *P. subtropica* are slender, cylindrical then becoming coralloid-branched, while in *P. inconspicua* they are globose then short-cylindrical, simple or very rarely sparingly branched. Further, *P. subtropica* contains minor or trace quantities of hypostictic and hyposalazinic acids in addition to the preponderant norstictic and connorstictic acids; the former two substances have not been observed in *P. inconspicua.* These two species are not sympatric, *P. inconspicua* only occurring in south-western Western Australia in contrast to *P. subtropica* which occurs in subtropical and tropical eastern Australia (Queensland and New South Wales). At present this new species is only known from the type collection.

Paraparmelia inselbergia Elix, sp. nov. Fig. 5

Species cum thallo ut in *Paraparmelia spodochroa* sed ab hac specie thallo diminuto, lobis angustioribus et acido constipatico et acido protoconstipatico continente differt.

Type: Australia. Western Australia. Yilliminning Rock, 18 km NE of Narrogin, 32°57'S, 117°22'E, 320 m, on large exposed granite outcrop, *J. A. Elix 41058, H. T. Lumbsch & H. Streimann*, 12.ix.1994; holo: CANB; iso: HO.

Thallus small-foliose to subcrustose, saxicolous, adnate, forming irregular rosettes, 1-2 cm wide. *Lobes* rarely imbricate, radiating at the apices, sublinear, subirregularly to subdichotomously branched, 0.3-1.0 mm wide. *Upper surface* pale ash-grey, black-marginate towards the lobe apices, flat, smooth and shiny at the tips, becoming dull, emaculate, developing dense granular pruina subapically, lacking soredia and isidia; older lobes becoming rugose, cracked and areolate. Medulla white. *Lower surface* pale tan to brown, darker towards the apices; rhizines sparse, simple, thick, to 0.2 mm long, concolorous. *Apothecia* scattered, subpedicellate, to 1.0 mm wide; disc globose at first, then concave becoming ±flat, dark brown to black-brown; thalline exciple thick, entire then ±cracked, densely pruinose. Ascospores ellipsoid, 7-9 x 4-5 μm. *Pycnidia* numerous, slightly emergent. Conidia weakly bifusiform, 5-6 x 1 μm.

Chemistry. Cortex K+ yellow; medulla K-, C-, P-; containing usnic acid, salazinic acid (major), consalazinic acid (minor), constipatic acid (minor/trace), protoconstipatic acid (minor/trace).

This species is characterized by the formation of tiny rosettes with pale ash-grey, narrow (0.3-1.0 mm wide), linear, radiating lobes, a pale lower surface and the production of salazinic, consalazinic and fatty acids in the medulla. *Paraparmelia sargentii* Elix & J.Johnst. exhibits similar morphological features, but differs in only containing constipatic and protoconstipatic acids in the medulla. *P. spodochroa* (Kurok. & Filson) Elix & J.Johnst., like *P. inselbergia,* produces salazinic and consalazinic acids in the medulla, has a pale lower surface and lacks vegetative propagules, but has larger thalli (3-4 cf. 1-2 cm wide) and broader lobes (1-2 mm cf. 0.3-1 mm wide) with an epruinose upper surface.

Specimen Examined

WESTERN AUSTRALIA. Slopes of Angwin Peak, Porongurups Range, Porongurups National Park, 19 km ESE of Mt Barker, 34°40'S, 117°51'E, 360 m, on granite rocks, *J. A. Elix 41318, H. T. Lumbsch & H. Streimann*, 17.ix.1994 (CANB).

Paraparmelia lumbschii Elix, sp. nov. Fig. 6

Species cum thallo ut in *Paraparmelia colensoica* sed ab hac specie thallo diminuto, lobis angustioribus et acido barbatico et acido 4-*O*-demethylbarbatico continente differt.

Type: Australia. Western Australia. Yilliminning Rock, 18 km NE of Narrogin, 32°57'S, 117°22'E, 320 m, on large exposed granite outcrop, *J. A. Elix 41066, H.. T. Lumbsch & H. Streimann,* 12.ix.1994; holo: CANB; iso: HO.

Thallus saxicolous, adnate to loosely adnate, 1-2 cm diam. *Lobes* slightly imbricate, sublinear, subirregularly to subdichotomously branched, narrow, 0.5-1 mm wide. *Upper surface* grey, blackening, flat, white-maculate, smooth and shiny towards the lobe apices, cracked and dull in thallus centre, isidiate; isidia sparse to dense, globose becoming cylindrical, simple at first but becoming coralloid-branched, inflated especially at the apices; isidia apices epicorticate, intact. Medulla white. *Lower surface* pale tan; rhizines sparse, simple, concolorous. *Pycnidia* and *apothecia* not seen.

Chemistry. Cortex K+ yellow; medulla K+ yellow-red, C-, P+ orange; containing atranorin, barbatic acid (major), 4-*O*-demethylbarbatic acid (minor).

Morphologically this species resembles *Paraparmelia colensoica* Elix & J.Johnst. since both have globose isidia which become cylindrical, a maculate upper surface and a pale lower surface, but is distinguished by the smaller thallus, narrower lobes, and the alternative medullary chemistry. *P. lumbschii* contains medullary barbatic acid (major) and 4-*O*-demethylbarbatic acid (minor) whereas *P. colensoica* contains colensoic acid (major) and norcolensoic acid (minor). These two species also occur in widely separated localities - *P. colensoica* in central Australia (Northern Territory) and *P. lumbschii* in south-western Western Australia. Currently this rare endemic species is only known from the type locality and is the first species of *Paraparmelia* known to contain barbatic acid. It is named in honour of our German lichenologist colleague, Dr H. Thorsten Lumbsch.

Parmotrema tongaense Elix, sp. nov. Fig. 7

Species cum thallo ut in *Parmotrema achrotrychum* sed ab hac specie lobis eciliatis differt.

Type: Tonga. Eua, Houma Makasea cliff edge, *ca.* 65 m, on dead wood in coastal forest, *W. R. Sykes* s.n., vi-vii.1977; holo: CHR.

Thallus corticolous or saxicolous, loosely adnate, membranaceous to coriaceous, to 10 cm wide. *Lobes* irregular, 4-20 mm wide, with rotund apices, entire or crenate; margins eciliate. *Upper surface* pale mineral grey, dull, emaculate, isidiate; isidia sparse to dense, laminal and marginal, confluent or in scattered groups, simple or branched, thinly cylindrical at first, fragile, becoming granular, irregularly inflated and subsorediate, brown tipped or concolorous. Medulla white. *Lower surface* smooth, shiny, black, with a broad, buff to pale brown, naked marginal zone, sparsely rhizinate, rhizines simple, short, *ca.* 0.1-0.5 mm long, coarse. *Apothecia* rare, laminal, subpedicellate, 5-12 mm wide; disc imperforate, concave or radially split, pale brown; thalline exciple thick, isidiate. Ascospores ellipsoid, 14-16 x 7-8 µm. *Pycnidia* not seen.

Chemistry. Cortex K+ yellow; medulla K-, C-, KC-, P-; containing atranorin, chloroatranorin, succinprotocetraric acid (major), protocetraric acid (minor), fumarprotocetraric acid (minor), protolichesterinic acid (minor/trace).

This new species is characterized by the eciliate lobes, the cylindrical isidia and the medullary succinprotocetraric, fumarprotocetraric and protocetraric acids. *Parmotrema tongaense* appears to be the isidiate counterpart of *P. judithae* Elix & J.Johnst. (sorediate), although no primary fertile species has been discovered. *P. tongaense* could be confused with *P. achrotrychum* (Kurok.) Streim. since these two species have identical medullary chemistry and comparable morphology, apart from the presence (or absence) of marginal cilia. *P. tongaense* also resembles the very common *P. tinctorum* (Nyl.) Hale but differs in having smaller thalli (5-12 cm *cf.* 10-30 cm wide), and medullary chemistry (*P. tinctorum* contains lecanoric acid). At present this new species is known only from Eua island in the kingdom of Tonga.

Specimens Examined

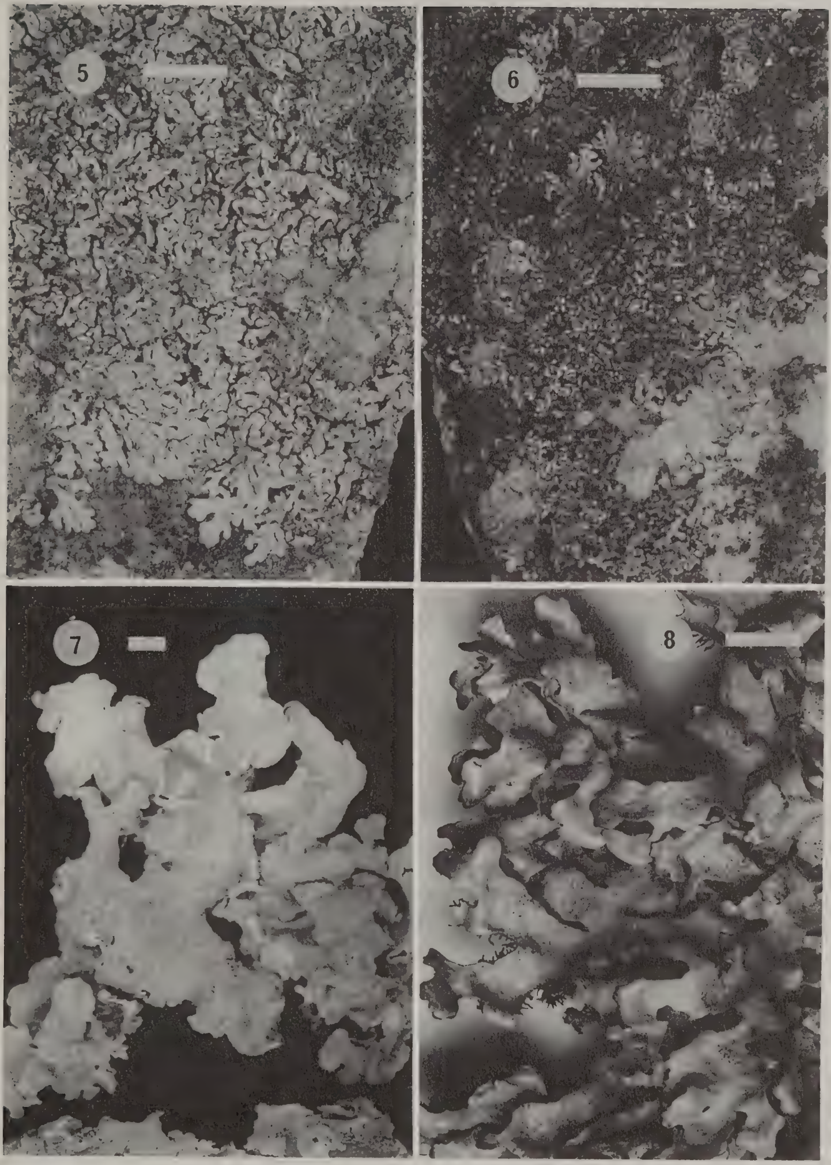
TONGA. Eua, north of Houma, Kahana area, *ca.* 70 m, in crevice on vertical rock face, *W. R. Sykes*, 22.vi.1977 (CHR); Eua, north of Houma, *ca.* 30 m, on dead wood, *W. R. Sykes*, 22.vi.1977 (CHR).

Xanthoparmelia norstrigosa Elix sp. nov. Fig. 8

Species cum thallo ut in *Xanthoparmelia substrigosa* sed ab hac specie lobis imbricatis, subconvexis et acido salazinico noncontinente differt.

Type: Australia. Western Australia. Boyagin Rock, Boyagin Nature Reserve, 20 km NW of Pingelly, 32°28'S, 116°53'E, 350 m, on large exposed granite outcrops, *J. A. Elix 40994, H. T. Lumbsch & H. Streimann*, 11.ix.1994; holo: CANB; iso: HO.

Thallus foliose, loosely adnate on rocks, 6-15 cm in wide. *Lobes* imbricate, subconvex, subirregular to linear-elongate, subdichotomously or irregularly divided; margins broadly sinuate, 1.5-4 (-8) mm wide. *Upper surface* yellow-green, shiny but becoming opaque and darkening with age,



Figures 5-8. New species of Parmeliaceae: 5, *Paraparmelia inselbergia* (holotype in CANB); 6, *Paraparmelia lumbschii* (holotype in CANB); 7, *Parmotrema tongaense* (holotype in CHR); 8, *Xanthoparmelia norstrigosa* (*J. A. Elix 10574 & L. H. Elix* in CANB). Scale bar = 5 mm

emaculate, lacking soredia and isidia but with numerous pycnidia, often black-margined particularly towards the apices of the lobes. Medulla white. *Lower surface* pale brown to dark blackish brown, with very dense, brush-like rhizines; rhizines brown to black, simple or often dichotomously branched. *Apothecia* adnate or substipitate, 4-7 mm in wide; disc concave, dark brown; the margin involute at first but later becoming undulating and developing irregular cracks. Ascospores ellipsoid, 8-10 x 4-6 µm. *Pycnidia* common; conidia bifusiform, 5-7 x 0.5 µm.

Chemistry: Cortex K-; medulla K+ yellow-red, C-, P+ orange; containing usnic acid, norstictic acid (major), connorstictic acid (minor).

Previously this species has been confused with *Xanthoparmelia substrigosa* (Hale) Hale since both are characterized by loosely adnate thalli, broadly sinuate lobes and characteristic very thick, brush-like rhizines. The lower surface of both species varies from pale brown to almost black, and they are rare among the *Xanthoparmeliae* in often having dichotomously branched rhizines. However they can be separated clearly by their chemical constituents; *X. substrigosa* contains usnic, norstictic (major), salazinic (major), connorstictic and consalazinic acids and *X. norstrigosa* contains only usnic, norstictic (major) and connorstictic acids. Morphologically *X. norstrigosa* differs in having subconvex, recurved, imbricate lobes while the lobes are more or less flat, commonly subascending and rarely imbricate in *X. substrigosa*. *X. norstrigosa* is confined to south western Western Australia, where it occurs on scattered granite inselbergs. *X. substrigosa* is a much more common and widely distributed species in southern and eastern Australia and New Zealand.

Specimens Examined

WESTERN AUSTRALIA. Howick Hill, *ca.* 75 km ENE of Esperance, *N. N. Donner 2855*, 2.x.1968 (AD); type locality, on granite rocks, *J. A. Elix 10570, 10574 & L. H. Elix*, 21.x.1982, *J. A. Elix 41008, H.. T. Lumbsch & H. Streimann*, 11.ix.1994 (CANB); Yilliminning Rock, 18 km NE of Narrogin, 32°57'S, 117°22'E, 320 m, on large exposed granite outcrop, *J. A. Elix 41045, H.. T. Lumbsch & H. Streimann*, 11.ix.1994 (CANB).

ACKNOWLEDGEMENTS

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AMANITA MORTENII—A CORRECTION. EMENDATION WAS INAPPROPRIATE

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Summary

During study of the paratypes of *Amanita mortenii*, it was thought that a number of them were not contaxic with the holotype. Study of several additional collections including observations on fresh material lead us to conclude that emendation of the species was inappropriate.

During study of the paratypes of *Amanita mortenii* reported by Tulloss (1994), several paratypes were segregated from the species based on anatomical observations that seemed to be correlated with pileus color variation. Examination of additional material including fresh collections has made it apparent that our emendation of *A. mortenii* was inappropriate—all of the original paratypes are contaxic with the holotype.

The pileus color of a recent collection (Borgen 94.74) was recorded as olivaceous (within the range of cap color of the holotype). However, photographs fortuitously taken the following day show a cap lacking olivaceous tints—falling into the brownish orange group of supposedly "nonconformant" paratypes. Hence, pileus coloration is apparently dependent on age and/or partial drying. Most of the new collections examined had spore shapes (as indicated by Q value) falling in between the values recorded for the supposedly distinct taxa that had been segregated from the original material. It may well be that the aging and drying associated with the color change is also associated with incomplete inflation of the spores or some other phenomenon that tends to increase Q.

With the macroscopic and spore character differences seriously called into question, supposed anatomical differences had to be re-examined. There were two such characters cited as supporting the nonconformity of the non-olivaceous capped paratypes—the presence of hyphae running parallel to the central stratum in the subhymenial base of the holotype and the absence of hyphae of diameter greater than 7.0 μm in the interior of the universal veil of the holotype. Thanks to the support of the Keeper at C, the holotype collection of *A. mortenii* was re-examined. The observation concerning the size of hyphae in the universal veil is simply wrong. Evaluating the subhymenium was more complicated due to the difficulty of fully rehydrating the tissue. In the poorly rehydrated tissue, alignment of cells is drastically altered; and all hyphal segments are collapsed or incompletely inflated. However, moderate success at rehydration was achieved in a few sections; and, in these cases, a structure of subhymenial elements clearly *perpendicular* to the central stratum was observed. In fact, at least locally (in the cited sections), *few or no* hyphae parallel to the central stratum were observed.

As a consequence of these observations, it is necessary to withdraw the emendation of *A. mortenii*. The case draws attention to the necessity of characterizing lamella trama based on well-dried and well-preserved material. Drying species of *Amanita* rapidly and preserving them from partial rehydration during storage is very important to study of their taxonomy. Tulloss takes responsibility for the erroneous emendation and for the anatomical misinterpretation. An expanded description of *A. mortenii* is provided below. It is based on all available material. A new figure of the lamella trama and hymenial elements is also presented.

Additional errata: Some corrections are made to collection citations found on the packets in C. The specimens formerly considered nonconformant with the holotype of this species and part of Borgen 85.133 actually represent a different collection (Borgen 85.260). Locality information has been corrected in the "collections examined" entry, below, for Borgen 85.133, J. H. Petersen 150, and J. H. Petersen 462.

Methods, terminology, and notation in this paper follow that of Bas *et al.* (1988) and Tulloss *et al.* (1992) as modified in Tulloss (1993 & 1994). Herbaria are cited by abbreviations according to Holmgren *et al.* (1990) with the exceptions of the authors' herbaria (TBORG for Borgen's and RET for Tulloss').

Color codes of the form "10YR 6/6" are from (Munsell Color, 1975). Color codes of the form "5A3" are from (Kornerup & Wanscher, 1978). In the body of the description, color codes in quotation marks are from the Colour Identification Chart of Henderson *et al.* (1969).

AMANITA MORTENII Knudsen & Borgen *in* Laursen *et al.* 1987. *Arct. Alp. Mycol.* 2: 244.

≡*Amanita mortenii* Knudsen & Borgen *emend.* Tulloss & Borgen *in* Tulloss. 1994. *Mycotaxon* 52: 353, Figs. 31-32. [Emendation in error.]

PILEUS: 35 - 75 mm wide, at first often olive-gray to olive-brown to predominantly olive-yellow (2.5Y 7/6) with darker yellow-brown between striae and whitish margin and with disc having pale grayish tint (about 10YR 7/2), eventually ocher (near 10YR 6/6) or ocher-brown (10YR 6/4) or ocher-gray (near 10YR 5/5) or warm ocher (10YR 5-6/8) or tan (less vivid than 2.5Y 7/6) or yellow-brown (less vivid than 2.5Y 6.5/6 with margin paler, about 2.5Y 7/3) or gray-brown or cardboard brown, sometimes somewhat darker (grayer) over disc (*e.g.*, 10YR 6-7/4), often paler toward margin [off-white or yellowish white to pale yellow (2.5Y 8/2-3) or pale grayish tan (10YR 7/4)], campanulate to conico-convex at first and subumbonate (in this form 24 - 52 mm wide and 19 - 40 mm high), eventually planar with or without distinct umbo, glabrous, tacky to dry, glistening when moist, dull to slightly shiny when dry, not hygrophanous; *context* white, sometimes sordid yellowish just below pileipellis, not discoloring when bruised or cut, rather soft and thin (*e.g.*, 1 - 2 mm thick at mid-radius, 5 mm thick at stipe); *margin* striate-sulcate (0.25 - 0.5R), striation rather faint at first although long even then, slightly decurved to straight; *universal veil* absent or as small, pale saffron "flakes" or as pallid small patches with gray margins (eventually entirely gray).

LAMELLAE: free to narrowly adnate with decurrent line on stipe apex, close, very pale buff (slightly paler than 10YR 8/2) to off-white in mass, white to whitish in side view, becoming off-white (*ca.* "2B") and then grayish with age, drying pale cream to pale grayish white to pale yellow or yellowish (3A2 or 4A3) to tan (5B4-5) to brown (a little browner than 5D5 or 5D7 or 10YR 6/4), with white [or at least in scattered places gray-brown (*e.g.*, 10YR 7/3)] flocculose edge, rather narrow (3.5 - 8 mm broad), subventricose; *lamellulae* truncate to subtruncate to subattenuate, of diverse lengths (often rather short), unevenly and sparsely distributed, occasionally adjoining stipe rather than pileus margin.

STIPE: 62 - 140 × 6 - 17 mm, white to off-white to very pale yellowish to very pale gray brown to very pale brownish buff to buff to very pale gray-brown (10YR 7/3) to light gray (10YR 7.5/1), palest toward apex, becoming grayish or pale gray-brown near bruises and wounds, pruinose to pulverulent near apex, becoming appressed fibrillose below (and then fibrils bearing pigmentation (when present) with exposed white ground between them), occasionally with lower surface breaking up into appressed scales, lacking strangulate zone as in *A. ceciliae* (B. & Br.) Bas; *context* white, becoming slightly grayish with age, rather brittle, hollow, with relatively broad central cylinder (up to 5 mm or more wide) occasionally having cross walls that become grayish buff (near 10YR 6/2); *exannulate*; *universal veil* as saccate volva, submembranous, appressed to or joining stipe for about lower third to half of limb height, with upper tip of limb 30 - 60 mm from base of stipe, fleshy, flexible at first, then rather fragile, 0.5 - 2 mm thick, with exterior pallid at first, becoming pale gray to gray (near 10YR 5/1 or 10YR 5/5 or 10YR 6/2), at times with saffron tint in free limb, at times with yellowish-orangish-ochraceous to yellow-brown (*e.g.*, 10YR 7/4-5) subpyramidal surface scales or spots or stains, paler toward stipe base (*e.g.*, 10YR 8/1 to pale brownish buff to grayish white to white), inner surface off-white to pale gray (*e.g.*, paler and purer gray than 10YR 6/2) or concolorous with exterior, with small whitish *limbus internus* placed at point of attachment between stipe and volval limb and at least sometimes white and floccose.

Odor lacking or almost so. *Taste* mild.

MACROCHEMICAL TESTS: Phenol - in stipe context, slowly pale reddish to pale salmon after 1 min., then vinaceous after 5 min.

PILEIPELLIS: 40 - 110 μm thick, rather easily separating from pileus context in holotype, with gelatinized surface colorless, otherwise orange-brown in 3% KOH with pigmented region extending into pileus context; filamentous, undifferentiated hyphae 1.0 - 5.2 (-7.0) μm wide, branching, densely packed vertically, subradially oriented, partially gelatinizing below surface, totally gelatinized at surface; vascular hyphae 2.0 - 8.8 μm wide, irregularly disposed, infrequent or relatively common locally. PILEUS CONTEXT: filamentous, undifferentiated hyphae 2.0 - 12.0 μm wide, branching, loosely interwoven singly or (often) in fascicles, sometimes with granular contents, with those of largest diameter having walls occasionally up to 0.8 μm thick; acrophysalides dominating except close to pileipellis, thin-walled or with walls up to 1.0 μm thick, broadly ellipsoid to ellipsoid to ovoid to broadly clavate to clavate to narrowly clavate to subfusiform, up to 148 × 63 μm; vascular hyphae 2.2 - 18.0 μm wide, uncommon to locally common. LAMELLA TRAMA: bilateral; w_{cs} = 40 - 55 (-70) μm; divergence at diverse angles, many at $90^{\pm}$°; subhymenial base including branching hyphae, subinflated branched elements, and inflated cells up to 65 × 27 μm or larger (irregularly distributed, broadly fusiform to narrowly clavate, often curved, diverging at angles from less than 30° to nearly 90°); filamentous, undifferentiated hyphae 1.2 - 6.5 μm wide, branching, densely interwoven in central stratum, in immature regions occupying much of trama, in mature material with rather common chains of short to moderately long inflated intercalary segments (fusiform to subfusiform to clavate, up to 56 × 18.5 μm); divergent inflated cells probably all intercalary, scattered to relatively common, single, thin-walled, broadly ellipsoid to ellipsoid to broadly clavate to clavate (up to 83 × 33 μm, mostly under 65 μm long), at many angles from aligned with central stratum to perpendicular to it, rather easily becoming free from original position in section; vascular hyphae 1.0 - 5.0 μm wide, branching, uncommon to scarce. SUBHYMENIUM: w_{st}-near = 45 - 70 μm; w_{st}-far = 60 - 90 μm; consisting of an interwoven structure of short and branching, uninflated to partially inflated to inflated hyphal segments (many roughly perpendicular to the central stratum), with basidia arising from all types of elements (dominantly from uninflated segments), with infrequent branches of uninflated hyphae parallel to central stratum in well rehydrated sections. BASIDIA: 36 - 71 (-77) × 11.0 - 19.0 μm, thin-walled, dominantly 4-, but also occasionally 1-, 2-, or infrequently, 3-sterigmate, thin-walled, with sterigmata up to 13.3 × 4.2 μm; clamps not observed. UNIVERSAL VEIL: *On pileus, exterior surface*: very thin layer (10 - 25 μm thick) of gelatinizing hyphae in fascicles, yellow to yellow-orange to brownish orange in 3% KOH, with fascicles separated by spaces through which interior visible. *On pileus, interior*: filamentous, undifferentiated hyphae 2.0 - 13.0 μm wide, with most 4.0 - 9.0 μm wide, singly and in small fascicles, branching, occasionally loosely coiled or twisted, sometimes constricted at septa, with walls thin or up to 0.8 μm thick (in hyphae of larger diameters), plentiful to locally dominant; inflated cells terminal singly, at times slightly sordid, scattered to locally dominant, subglobose to ellipsoid to broadly clavate to clavate (up to 70 × 52 μm), with walls thin or up to 1.0 μm thick; vascular hyphae not observed. *On pileus, inner surface*: gelatinized, otherwise like interior. *At stipe base, exterior surface*: as on pileus, with most fascicles longitudinally oriented; filamentous, undifferentiated hyphae 3.2 - 5.0 μm wide, branching; vascular hyphae $3.2^{\pm}$ μm wide, branching, not common. *At stipe base, interior*: filamentous, undifferentiated hyphae 2.2 - 15.0 (-18.2) μm wide, branching, loosely interwoven in fascicles (including few hyphae of large diameter) and singly, plentiful to locally dominant, some loosely coiled or with small groups of rather tight kinks closely spaced, thin-walled or with walls to 0.8 μm thick (especially in near-terminal segments), occasionally with slightly swollen intercalary segments; inflated cells dominant throughout much of tissue (especially in uppermost parts of limb) or locally scattered, terminal singly or in chains of up to four cells, often pale sordid or pale brownish or yellowish brown, globose to subglobose to subpyriform to broadly ellipsoid to ellipsoid (up to 78 x 69 μm) or broadly clavate to clavate to fusiform (up to 116 × 60 μm, but almost always with major diameter less than 80 μm), with walls thin or up to 1.2 μm thick; vascular hyphae 2.0 - 7.0 μm wide, scattered to rare. *At stipe base, inner surface*: gelatinized, often like interior, but occasionally consisting of remnants of very thin layer of longitudinally oriented, narrow diameter hyphae. STIPE CONTEXT: longitudinally acrophysalidic; filamentous, undifferentiated hyphae 1.8 - 10.5 μm wide, branching, plentiful to dominating, often in fascicles, with walls up to 0.5 μm thick; acrophysalides common to plentiful, subventricose to narrowly clavate to clavate, up to 220 × 55 μm (mostly under 160 μm long), with walls thin or up to 1.0 μm thick; vascular hyphae 1.2 - 8.0 μm wide, branching, unevenly distributed (locally uncommon to locally plentiful).

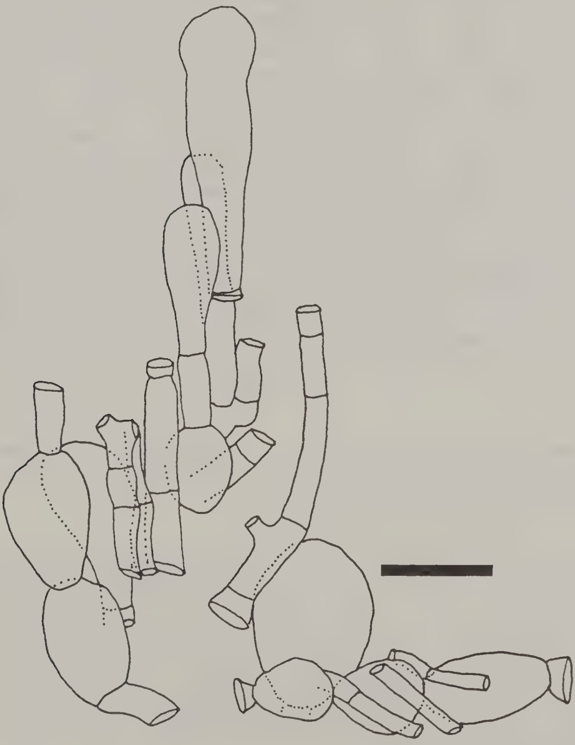

Fig. 1 *Amanita mortenii* (Borgen 84.172). Elements of hymenium and lamella trama. The dark bar represents 20 μm.

BASIDIOSPORES: [451/23/12] (8.5-) 9.5 - 13.0 (-17.0) × (7.2-) 8.5 - 11.5 (-15.0) μm, (**L** = (10.1-) 10.3 - 11.8 (-11.9) μm; **L'** = 11.0 μm; **W** = 8.9 - 10.6 (-10.9) μm; **W'** = 10.0 μm; Q = (1.0-) 1.03 - 1.22 (-1.47); **Q** = 1.06 - 1.17 (-1.18); **Q'** = 1.10), hyaline, colorless, smooth, thin-walled, inamyloid, subglobose to broadly ellipsoid, infrequently globose or ellipsoid, usually at least somewhat adaxially flattened, sometimes swollen at one end; apiculus sublateral, truncate-conic to cylindric, sometimes rather large relative to spore size; contents mono- to multiguttulate to granular; off-white (*ca.* "2B") in deposit.

Habitat and distribution: Not uncommon locally, subgregarious, in subarctic to low arctic habitat, at 10 - 75 m elev. On acid dwarf-scrub heath in fjords near *Betula glandulosa* Michx. with *Empetrum nigrum* L. subsp. *hermaphroditum* (Hagerup) Böch and *Cladonia spp.* or with grasses, *Cladonia*, and *Stereocaulon* or on gravelly soil among mosses near *B. glandulosa* with *Cladonia*, *Cetraria*, and *Empetrum* or scattered on dry heath among *B. glandulosa* and *Empetrum sp* or with *B. glandulosa*.

Collections examined: **GREENLAND**: Ivittuut Municipality—"Ellerslie havn" [61°19'N/48°8'W], 10 km E of Kangilinnguit/Grønnedal on opposite side of fjord, 13-14.viii.1985 T. Borgen 85.133 (paratype, C). Paamiut (Frederikshåb) Municipality—at head of Eqaluit fjord, 25 km E of Paamiut [62°3'N/49°25'W], 11.viii.1981 T. Borgen 81.119 (paratype, C), 24.viii.1984 T. Borgen 84.172 (paratype, C), 29.viii.1985 T. Borgen 85.260 (RET; TBORG), 24.viii.1986 T. Borgen 86.257 (RET; TBORG), 10.viii.1993 T. Borgen 93.107 (TBORG), 19.viii.1993 T. Borgen 93.133 (TBORG), 28.viii.1993 T. Borgen 93.167 (TBORG), 27.viii.1984 T. Borgen 94.74 (RET; TBORG); Eqaluit at end of fjord [62°4'N/49°23'W], 19.viii.1973 P. M. Petersen 73.319 (paratype, C). Near Narssarssuaq - Rosenvinges Plantation [61°14'N/45°32'W], 29.vii.1983 H. Knudsen, T. Borgen, & Jens H. Petersen [J. H. Petersen 150] (holotype, C). Qassit Kangerluarsua, at head of fjord, 20.viii.1994 T. Borgen 94.45 (TBORG). Qinngua Valley—Taserssuaq Lk. [60°16'N/44°33'W], 13.viii.1983 H. Knudsen, T. Borgen & J. H. Petersen [J. H. Petersen 462] (paratypes, C & L).

DISCUSSION

On the pileus surface of some specimens one may often find clusters of partially gelatinized inflated cells from the formerly adjacent portion of the universal veil. This is not uncommon in section *Vaginatae*.

J. H. Petersen 151 (a paratype of *A. mortenii*) comprises a single, immature specimen lacking spores which is tied to a card with nylon thread. This specimen was collected on the same date and in the same locality as the holotype of *A. mortenii*. There is a color photo in C depicting two basidiocarps with graying, submembranous universal veil and having an orangish brown pileus. The back of this photograph is marked "HK, TB, JP 151." On the grounds of this photo and given the evidence that pileus color is not sufficient to cause breaking up the present taxon, the specimen is probably assignable to *A. mortenii*.

ACKNOWLEDGMENTS

We thank Dr. C. Bas (L) for sponsoring loans to Tulloss from his institution; Dr. Henning Knudsen (C) for his correspondence on this topic and for his support in arranging loans to Tulloss of the type materials of *A. mortenii*, *A. groenlandica*, and other Greenlandic taxa; Dr. Gary A. Laursen, University of Alaska—Fairbanks, for his reviewing this paper; and Ms. Mary A. Tulloss, Roosevelt, New Jersey, for assistance in preparing the final paper for publication.

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POLYPORES FROM PAPUA NEW GUINEA : SOME NEW SPECIES

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Summary

Three new polypore species are described from Papua New Guinea : *Dichomitus papuanus*, *Polyporus aurantioporus* and *Trametes lunospora*. The genus *Dichomitus* is recorded for the first time for the polypore flora of Papua New Guinea. *Polyporus aurantioporus* is discussed in relation to the *Polyporus grammocephalus*-group.

Introduction

The polypores* of Papua New Guinea have a long history of exploration (see Berkeley 1877; Cooke 1885-1886; Hennings 1892, 1894 and 1898a+b). In modern times Cunningham (1965) reports on the polypores of this region and Shaw (1984) provided a check list of the polypores. In his series 'Ad Polyporaceas' (1983, 1984, 1987, 1989a+b and 1991) Corner also reports some polypores from the country. But a polypore flora of the region is still missing.

Several Belgian botanists have in recent years explored Papua New Guinea and collected many polypores. The study of these specimens left three species without a proper name and which here are described as new. Besides, the complex of species around *Polyporus grammocephalus* (the *P. grammocephalus*-group) is elucidated in this paper.

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* The term polypores is used here in a broad sense, comprising most poroid Aphyllophorales.

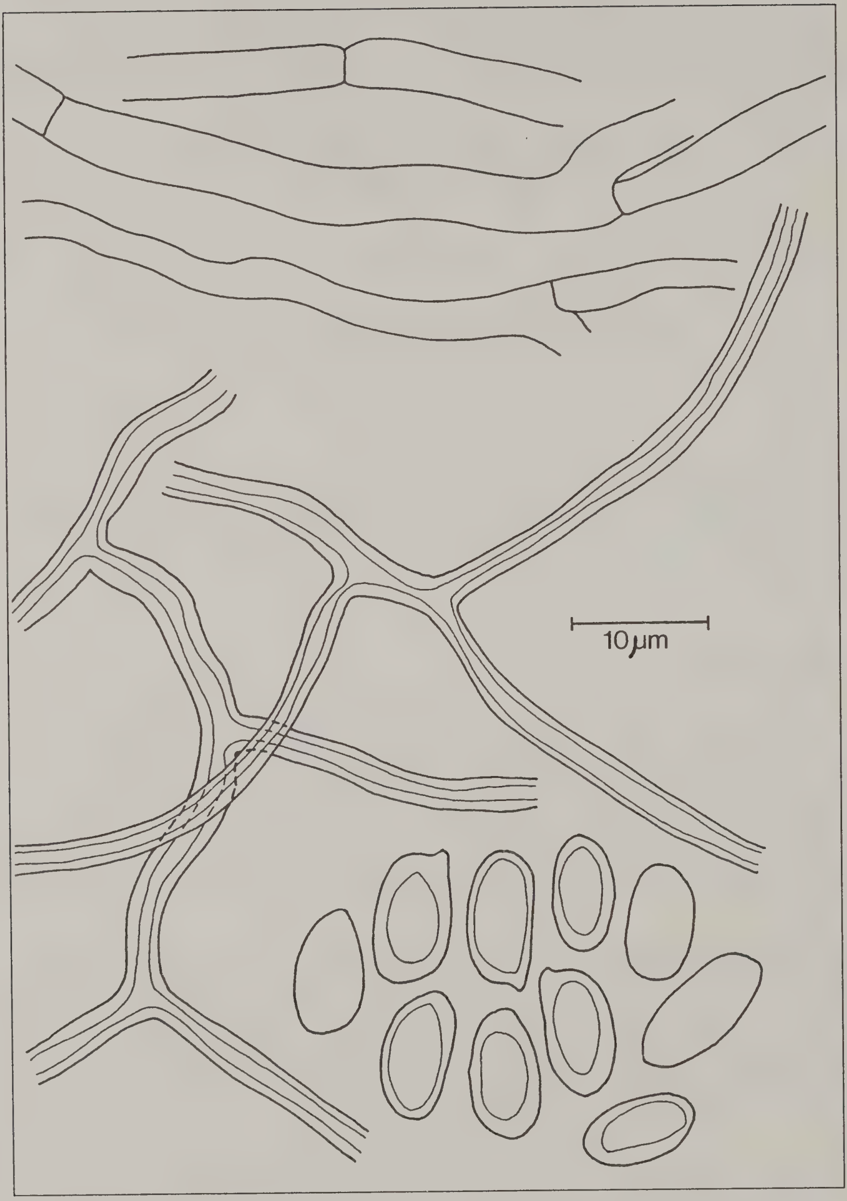

Fig. 1. Dichomitus papuanus *(H. Mervielde HM/PNG/253): a. generative hyphae of subiculum; b. binding hyphae of subiculum; c. basidiospores.*

Materials and Methods

Most of the exsiccata were collected during expeditions to Papua New Guinea since the last decade. These collections (of E. Coppejans, P. Goetghebeur, H. Mervielde, E. Quanten, K. Van der Gucht & L. De Meester, P. Van der Veken and W. Vyverman) are deposited in the Herbarium of Ghent University (GENT), Belgium. Other exsiccata were obtained from the Herbarium of Kew (K), U.K., Leiden (L), Netherlands and Liège (LG), Belgium.

The hyphal system was analysed according to the method of Teixeira (1956 & 1962) by teasing apart the contextual and tramal hyphae. Mounts were made in KOH (5 % aqueous solution), Congo Red (1 % aqueous solution) and Melzer's reagent. Spore dimensions were taken from spores present in slide preparations of the tubes. For the S.E.M. preparations the procedure of O'Donnell & Hooper (1974) was followed. Terminology follows Gilbertson & Ryvarden (1986). For the colour code the Methuen Handbook of Colour (Kornerup & Wanscher 1978) was used.

Description of species

Dichomitus papuanus Quanten, sp. nov. Fig. 1.

Fructificatio annua et resupinata; in stato sicco lenta; alba cremea, 3 cm longa, 1.7 cm lata et ad 0,4 mm crassa. Pori cremei ochracei, primo rotundi, dein lacerati, 125-175 µm lati (4-5 /mm). Dissepimenti 100-150 µm crassi, margine lanati. Tubi subiculum concolores, 100-150 µm longi. Contextus cremeo-flavus usque ad ochraceus, floccosus, 150-250 µm crassus. Systema hypharum dimiticum. Hyphae generativae non fibulatae, summe frequentae, hyalinae, tenuitunicatae, 2.5-4.5 µm diametro, frequentae ramosae in angulo acuto. Hyphae ligativae hyalinae, crassae tunicatae, 1.5-3 µm diametro, arboriformes cum longis ramis. Cystidia nulla. Basidia clavata cum 4 sterigmatibus. Sporae late cylindricae ad ellipsoideae, 9-11.7 x 4.6-6.6 µm, glabrae, hyalinae, nec amyloideae nec dextrinoideae, tenuitunicatae.

HOLOTYPUS : H. MERVIELDE, HM/PNG/253, way to Kamba, Madang Province, Papua New Guinea (GENT).

BASIDIOCARP : annual. Resupinate. Tough when dry. Whitish cream, broad margin, woolly byssoid. Easily separable from substrate. About 3 cm long, 1.7 cm wide and papery thin, 250-400 µm.

PORE SURFACE : cream ochraceous, first round but soon becoming lacerate, 4-5 pores/mm, 125-175 µm wide. Thick dissepiments with woolly edges, 100-150 µm. Tubes concolourous with subiculum, 100-150 µm deep, not stratified.

SUBICULUM : cream yellowish to ochraceous, soft floccose, 150-250 µm thick.

HYPHAL SYSTEM : dimitic. Generative hyphae without clamps, very frequent, hyaline, thin-walled, 2.5-4.5 µm Ø (Congo Red, Melzer's reagent), frequently branched at acute angle. Vegetative hyphae of the binding type: frequently to abundantly branched, arboriform with long branches, interwoven, hyaline, thick-walled, 1.5-3 µm Ø (Congo Red, Melzer's reagent).

CYSTIDIA : absent.

BASIDIA : clavate with 4 sterigmata.

BASIDIOSPORES : broad cylindric to oblong ellipsoid, 9-11.7 x 4.6-6.6 µm (Congo Red, Melzer's reagent), hyaline, non-amyloid and non-dextrinoid, smooth, thin-walled.

HABITAT : on the internal side of a dead bamboo-shoot.

DISTRIBUTION : Papua New Guinea.

REMARKS : The wide pores, large spores and the dimitic hyphal system with the binding hyphae are pointing to *Dichomitus leucoplacus* (Berk.) Ryv., which however has clamped generative hyphae, while this specimen lacks any clamp (see table 1). *Wolfiporia* comprises resupinate species with simple septate generative hyphae, binding hyphae and large spores. This genus is by all characterized by wide (up to 20 µm) generative hyphae, a phenomenon which was not observed in this specimen. Although clamps are missing, this species is described in *Dichomitus* with clamped, but small generative hyphae, instead of *Wolfiporia* with clampless, but wide generative hyphae. Also in the genus *Polyporus* there are several species with clampless generative hyphae among species with clamped generative hyphae.

This genus was not recorded for Papua New Guinea before.

EXSICCATUM :
MADANG PROVINCE : H. MERVIELDE, HM/PNG/253, way to Kamba (holotypus, GENT).

Table 1.

	Dichomitus papuanus	*Dichomitus leucoplacus*
Habitus	resupinate	resupinate
Pores (/mm)	4-5	2-3
Hyphal system	dimitic (binding hyphae)	dimitic (binding hyphae)
Generative hyphae	**simple septa**	**clamped septa**
Basidiospores	cylindric- oblong ellipsoid	cylindric
(µm)	9-11.7 x 4.6-6.6	10.3-12.5 x 4.7-5.6

Polyporus aurantioporus **Quanten, sp. nov.** Fig. 2.

Fructificatio annua, plerumque solitaria, sessilis, basis lateraliter attenuata vel plerumque pleuropodalis, 9 cm longa, 7 cm lata et 3-6 mm crassa. In vivo pinguis vel lenta, in stato sicco summe lenta vel dura. Pileus flabelliformis, spathulatus vel dimidiatus, neque sulcatus neque zonatus. Flammeo-fuscus, cinnamomeus, ochraceus usque ad pullus. Quasi radio-striatus. Superficies glabra, sine crusta. Margo tenuis, acuta, dentata; in statu sicco fragilis et deflexa. Stipes lateralis, cylindricus vel dorso-ventralis ad basim. Flammeo-fuscus, cinnamomeus, ochraceus ad pullus. Quasi 1 cm longus et 1 cm latus. Pori flammeo-cremei, fusco-flammei, roseo-rubri. Pori rotundi, interdum angulati, 75-150(-200) µm lati (5-7 /mm). Dissepimenti 50-75(-100) µm crassi. Tubi flammeo-cremei, 0.5-1(-1.5) mm longi. Contextus cremeus, floccosus. Systema hypharum dimiticum. Hyphae generativae fibulatae, hyalinae, tenuitunicatae, 2-4.5 µm diametro. Hyphae ligativae summe abundantes, hyalinae, crassae tunicatae usque ad subsolidae, arboriformes, frequenter ramosae, 2.5-5.5 µm diametro. Cystidia nulla. Sporae cylindricae usque ad ellipsoideae, 6.5-9.5(-10) x 2.3-3.3(-3.8) µm, glabrae, hyalinae, non amyloideae nec dextrinoideae, tenuitunicatae.
HOLOTYPUS : E. QUANTEN, EQ 1535, 27.10.1989, on dead rotten branch, lowland rain forest, alt. 200 m, 16 km beyond Gogol River, direction Lae, Madang Province, Papua New Guinea (GENT).

BASIDIOCARP : annual, solitary, less frequent in clusters. Pileate, applanate, rarely imbricate, mostly semi-stipitate or with a short stipe (with decurrent, but sharply delimited pores), less frequent sessile. Up to 9 cm long, 7 cm wide and 3 mm thick, 6 mm at the base. Not darkening in KOH. Fleshy to tough when fresh, very tough to hard when dry. PILEUS : flabelliform, spathulate, to dimidiate, rarely circular. Asulcate and azonate. 6(C-D-E)(6-7) + 6E5: orange brown, greyish ochraceous, cinnamon orange, dark orange, cinnamon grey, sunburn, camel grey, camel to dark (reddish) brown; more or less radially striate. Surface glabrous, without a crust. Margin thin, acute, crenulate-dentate, rather brittle and deflexed when dry; sterile margin absent. STIPE : lateral or with a lateral tapering base. Cylindric to discoid at the base or dorsi-ventrally flattened towards the base. Upper surface concolourous with the pileus. Mostly about 1 cm long and 1 cm Ø. Pore surface orange cream, brownish orange, pinkish to reddish buff, reddish orange.
PORES : mostly round, less frequently angular, regular and not radially elongated, minute, 5-7(-8) pores/mm, 75-150(-200) µm wide. Dissepiments relatively thick compared with the pore width: 50-75(-100) µm, hyphal pegs variably absent to very abundant. Tubes one-layered, orange cream, slightly contrasting with the context, mostly about 0.5-1(-1.5) mm long.
CONTEXT : cream, floccose-cottony, coriaceous layer absent, 1-2 mm thick.

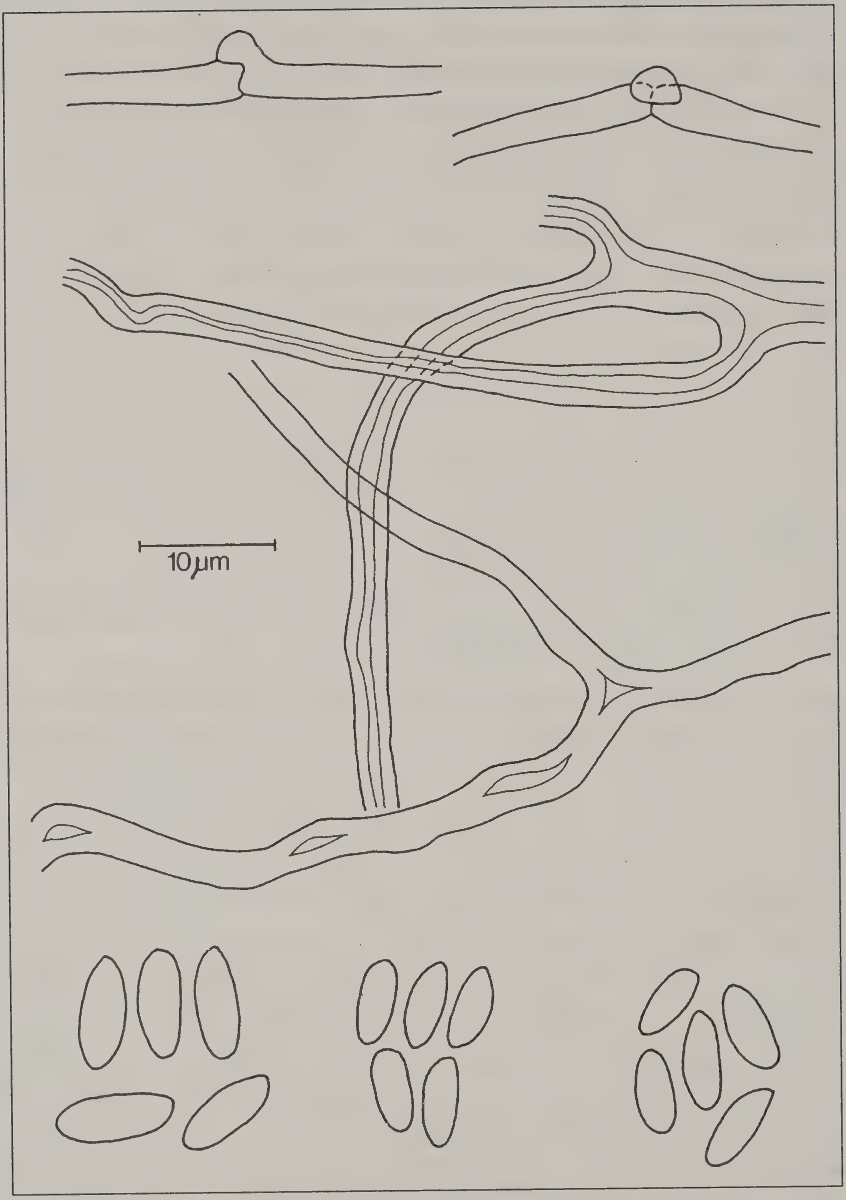

Fig. 2. Polyporus aurantioporus: *a. generative hyphae of context (E. Quanten EQ 1215); b. binding hyphae of context (EQ 1215); c-e. basidiospores (c. E. Quanten EQ 1215; d. EQ 1535; e. P.A. Wright s.n.).*

HYPHAL SYSTEM : dimitic. Generative hyphae with clamps, frequent but often difficult to observe, hyaline, thin-walled, 2-4.5 µm Ø (Congo Red). Binding hyphae dominant, hyaline, thick-walled to almost solid, arboriform and frequently branched, 2.5-5.5 µm Ø (Congo Red).

CYSTIDIA : absent.

BASIDIOSPORES : cylindric to oblong ellipsoid, 6.5-9.5(-10) x 2.3-3.3(-3.8) µm (Congo Red), smooth, hyaline, non-amyloid and non-dextrinoid, thin-walled.

TYPE OF ROT : white rot.

HABITAT : on bark and wood of rotten branches and fallen tree stems of deciduous wood. Frequent in lowland rain forests.

DISTRIBUTION : Papua New Guinea. Also occuring in Borneo and the Solomon Islands (see Corner 1984:101 as *Polyporus philippinensis* var. C and D).

REMARKS : on the ***Polyporus grammocephalus*** **-group**

This group comprises the following traditional species: *P. grammocephalus* Berk., *P. moluccensis* (Mont.) Ryv. (*Favolus spatulatus* (Jungh.) Lév.), *P. philippinensis* Berk. and *P. tenuiculus* (Beauv.) Fr. (*Favolus brasiliensis* (Fr.) Fr.) together with the newly described *Polyporus aurantioporus*. These species share many characters (form of pileus, mostly with tapering base, semi-stipitate to laterally stipitate, angular pores, dimitic hyphal system with binding-like hyphae, cylindric spores) with intermediate and overlapping forms. Identification is often difficult and in herbaria collections are often mixed. After having examined a large number of specimens, the following conclusions can be given:

1. A new species *Polyporus aurantioporus* is described: this new species corresponds to *P. philippinensis* var. C and var. D by Corner (1984:101). It can be distinguished from the other species by:
   - a relatively dark camel to orange brown greyish pileus, glabrous;
   - pore surface always with distinct orange to buff hue;
   - round pores, if more or less angular then never radially elongated;
   - 'minute' pores;
   - relatively thick dissepiments;
   - short tubes.
2. *Polyporus moluccensis* (Mont.) Ryv. is within the traditional four species the best defined:
   - white to cream pileus and pores becoming much darker upon drying;
   - fine tomentum present;
   - presence of a conspicuous crust and of a coriaceous layer above the tubes formed by agglutinated hyphae;
   - context fibrous;
   - tubes contrasting with the context;

- the papery thin dissepiments, distinctly fimbriate.

3. The other three traditional species are more difficult to characterize:
   - *P. tenuiculus* (Beauv.) Fr. and especially *P. philippinensis* Berk. are very remarkable by the large, hexagonal pores, more than 0.5 mm wide! The former species is white to cream coloured when fresh (but can become much darker in old herbarium species), astriate, glabrous and with white to cream pores.
   - *P. philippinensis* in contrast is more straw-coloured, ochraceous to cinnamon, is finely radially striate and scrupose at the base; hyphal pegs are mostly very abundantly represented and the spores are in general larger than in *P. tenuiculus.*
   - *P. grammocephalus* Berk. includes specimens with faintly to distinctly striate or veined pilear surface, glabrous to scrupose at the base; pores round to angular, relatively small but variable (less than 0.5 mm wide); spores, although variable never exceeding 8 µm in length. The characters in this species are not constant, the range given for pore and spores size is large : pores (/mm): 2-4(-6); (4-)5-6; 6-8; spores (µm): 5.5-7.5(-8) x 2.2-3; 4.7-5.2 x 2.8-3.3; 6.5-8 x 3.2-3.8

It is not surprising that these variable species have been described as new over and over again. Corner (1984) lists several varieties for most of these species, but because the delimitation of the species is already poor, these varieties are overlapping. In this case it is not practical to distinguish varieties for these species. Culturing characteristics and mating tests are badly needed to give more support to these species.

EXSICCATA : BÄUERLEN, 25, 1885, Strickland River (K!: labelled as *Polyporus russiceps* Berk., filed under *Polyporus grammocephalus* Berk.); 45, on branch, Fly River (K!: as *Polyporus russiceps* Berk., filed under *Polyporus grammocephalus* Berk.).
ADMIRALTY ISLANDS : Challenger expedition, 03.1875 (K!: filed under *Polyporus grammocephalus* Berk.).
EAST SEPIK PROVINCE : E. QUANTEN, EQ 2399 + EQ 2407, 15.05.1992, on fallen rotten branch, lowland rain forest, alt. 40-60 m, 144°12'50"E 4°12'10"S, Taway.
MADANG PROVINCE : H. MERVIELDE, HM/PNG/122, 27.08.1990, on fallen hardwood tree stem, wet primary forest on hill slope, beside a small river, between Kauris and Opi. E. QUANTEN, EQ 1385, 26.10.1989, on rotten branch, lowland rain forest, alt. 500 m, 24 km from Tapo Creek, direction Ramu Valley; EQ 1426, 27.10.1989, on wood of rotten branch, lowland rain forest with tall undergrowth, alt. 250 m, 25 km beyond Gogol River, direction Lae; EQ 1535, 27.10.1989, on dead rotten branch, lowland rain forest, alt. 200 m, 16 km beyond Gogol River, direction Lae (Holotypus, GENT); EQ 2014, 03.05.1992, on fallen branch, strongly disturbed secondary lowland rain forest, alt. 50-100 m, 145°45'30"E 5°7'40"S, Amron Mission; EQ 2056 + EQ 2066, 04.05.1992, on rotten fallen branch, lowland rain forest, alt. 0-50 m, 145°43'40"E 5°19'10"S, Balek Wildlife Sactuary; EQ 2287, 10.05.1992, on wood of fallen tree stem, forest with a lot of bamboo, sea level, 144°46'30"E 4°12'S, Sepen n°1; EQ 2686 + EQ 2694, 25.05.1992, on fallen tree stem or on rotten wood, flood plane forest, alt. 150-200 m, 145°22'E 5°45'50"S, Brahman Mission; EQ 2726 + EQ EQ 2769, 26.05.1992, on wood of fallen

branch, very wet primary rain forest with a lot of undergrowth, alt. 150-200 m, 145°22'30"E 5°46'30"S, near Brahman Mission; EQ 2837 + EQ 2841, 26.05.1992, rather dry rain forest on hill slope, alt. 200-250 m, 145°22'40"E 5°46'50S, near Paiya village; EQ 2906, EQ 2952 + EQ 2966, 27.05.1992, on bark and wood of fallen branches, rather wet lowland rain forest, alt. 200(-250) m, 145°19'40"E 5°44'S, road to Bundi (forest near bridge); EQ 3006, 27.05.1992, on rotten wood, swamp forest dominated by *Pandanus* and sago, alt. 120 m, road between Ramu and Kausi; EQ 3015, 28.05.1992, on rotten branch, 145°25'E 5°40'40"S, between bridge over Ramu River and the Ramu Highway; EQ 3054 + EQ 3071, 29.05.1992, on rotten branch, primary lowland rain forest, 145°43'40"E 5·19'10"S, Balek Wildlife Sanctuary; EQ 3138, 02.06.1992, on fallen branch, lowland rain forest, sea level, 145°44'40"E 5°0'20"S, Baiteta; EQ 3161, 02.06.1992, on rotten branch, lowland rain forest, sea level, 145°44'40"E 5°0'20"S. K. VAN DER GUCHT & L. DE MEESTER, 89-1805, 11.11.1989, on dead wood, rain forest, alt. 150 m, 5°19'S 145°43'E, Balek Wildlife Sanctuary.

MOROBE PROVINCE : H.E. BROWN, HEB 5028b, 18.02.1967, on rotten wood, sea level, old hospital site, Malahang, Lae (K!: filed under *Polyporus grammocephalus* Berk. var. *loignosus*). E. QUANTEN, EQ 1064, 15.10.1989, on rotten wood, remnant of swamp-like lowland rain forest, sea level, Ampo mission, Butirum road, Lae; EQ 1215, 23.10.1989, on dead standing tree, disturbed secondary rain forest, alt. 300 m, 15 km from Lae (bridge over Butibum River) direction Gawan, along Sankwep River. P.A. WRIGHT, s.n., 14.09.1968, rotting wood, Manki logging area, Bulolo (K!).

NEW BRITAIN : P.A. WRIGHT, FM 607, 02.04.1968, rotting wood on forest floor, alt. 2500 feet, 4°48'S 151°49'E, Lakit (K!: filed under *Polyporus grammocephalus* Berk.).

Trametes lunospora Quanten, sp. nov. Fig. 3.

Fructificatio annua, solitaria vel fasciculata, pilei lateraliter confluentes, imbricati, sessiles, basis angusta vel brevis lateraliter stipitati, usque ad 6 cm longa, 4-5 cm lata et 2-3(-8) mm crassa. Pileus applanatus, dimidiatus, flabelliformis vel spathulatus, plerumque concentrico sulcatus. Non zonatus vel modice zonatus. Flavo-albus, albus, cinereo-flammeus. Superficies sine crusta, glabra et saepe nitida. Margo tenuis et acuta, in statu sicco paula undulata. Stipes absens vel lateralis, brevis et solidus, dorso-ventralis. In vivo albus, in statu sicco cremeus. Usque ad 3 mm longus et 4 mm latus. Superficies glabra. Pori rotundi vel angulati, cremei, flavi ad cinereo-flammei, 125-175(-200) µm lati (5-7(-8) /mm). Dissepimenti 30-40 µm crassi. Tubi flavo- albi vel albi, maximum 1 mm longi. Contextus flavo-albus vel albus, 1-1.5 mm crassus, floccosus usque ad fibrosus. Systema hypharum trimiticum. Hyphae generativae fibulatae, hyalinae, tenuitunicatae, 1.5-4(-4.5) µm diametro, ramosae in angulo acuto. Hyphae skeletales (dominant), hyalinae, crassae tunicatae, 2.5-7 µm diametro. Hyphae ligativis abundantes, hyalinae, crassae tunicatae, 1.5-4 µm diametro, arboriformes cum longis et proceris ramis. Cystidia nulla. Basidia clavata cum 4 sterigmatibus. Sporae proceris cylindricae usque ad allantoideae, (6.5-)7.5-10.5 x 2-2.5(-3) µm, hyalinae, glabrae, nec amyloideae nec dextrinoideae, tenuitunicatae.

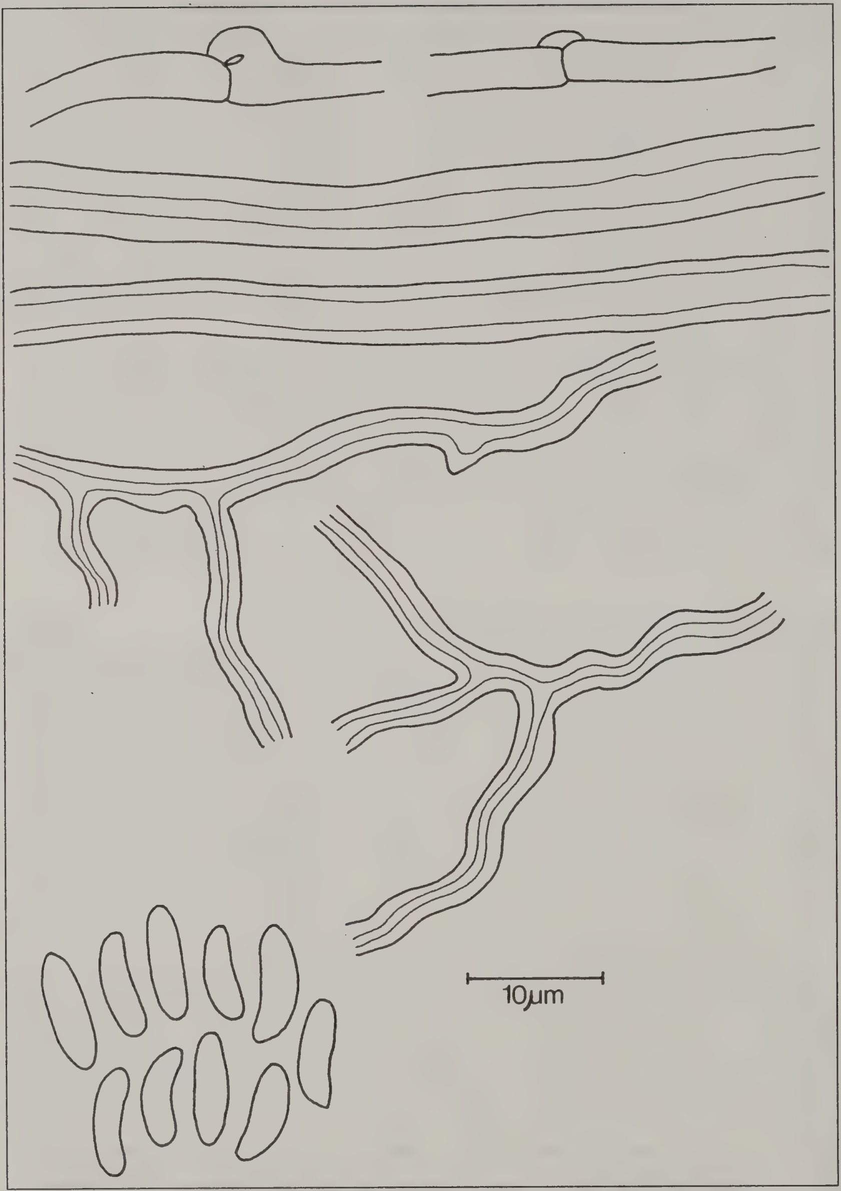

Fig. 3. Trametes lunospora *(E. Quanten EQ 1037): a. generative hyphae of context; b. skeletal hyphae of context; c. binding hyphae of context; d. basidiospores.*

HOLOTYPUS : P. GOETGHEBEUR & W. VYVERMAN, 6250, 30.08.1987, on rotten wood, montane rain forest, alt. 1840 m, c. 7°32'S 146°48'E, bridge over rivulets Elek + Kak, 35 km,Wau - Garaina, Morobe Province, Papua New Guinea (GENT).

BASIDIOCARP : annual, solitary or in clusters, imbricate and lateral pilei fused. Pileate, applanate, sessile and narrowly attached by a lateral contracted or tapering base, or with a short lateral stipe. Up to 6 cm long, 4 to 5 cm wide and 2-3 mm thick or even 4-8 mm at the base. PILEUS : semi-circular to dimidiate, flabelliform or spathulate, mostly (slightly) concentrically sulcate. Azonate or only faintly so; colours varying from yellowish white - white - light yellow - greyish orange - (yellowish grey) [3A(1-3) - 4(AB)4 - 4B2 - 5B(5-6)]. No cuticle or crust present, glabrous and often slightly shiny. Margin thin and acute, entire; when dry slightly undulating, rarely recurved. STIPE : absent or lateral, short and stout, dorso-ventrally; white when fresh, drying cream. Up to 3 mm long and about 4 mm Ø. Smooth to glabrous. Pore surface cream - light yellow - light to greyish orange [4A(3-4) - 5A5 - 5B4], seldom reddish golden.

PORES : round to angular, not distinctly elongated or radially orientated, (4-)5-7(-8) /mm, about 125-175(-200) µm wide. Dissepiments about 30-40 µm thick. Tubes yellowish white to cream [(3-4)A2 - 4A(2-3)], less than 1 mm long (even less than 0.5 mm); not stratified.

CONTEXT : yellowish white or white [3A(2-1)], 1-1.5 mm thick, floccose-cottony to compact fibrous.

HYPHAL SYSTEM : trimitic. Generative hyphae clamped, frequent, hyaline, thin-walled, 1.2-2.5 µm Ø in the pilear surface, 1.5-3.2 µm Ø in the margin and up to 4(-4.5) µm Ø in the context, branched at acute angles; more or less agglutinated in the pileus surface. Skeletal hyphae dominant in surface, margin and context, hyaline, with thick to very thick walls and narrow lumen; 2.5-5.6 µm Ø in the pilear surface and no branching observed; 3.2-5.6 µm Ø in the margin, branched; 3.2-7 µm Ø in the context and branched. Binding hyphae observed in the context, where they are abundant, hyaline, thick- to very thick-walled, (1.2-)1.5-4 µm Ø, arboriform with long and slender branches. In the margin binding hyphae are sparse. Both types of vegetative hyphae densely interwoven. (Measurements in Congo Red).

CYSTIDIA : none.

BASIDIA : clavate with 4 sterigmata.

BASIDIOSPORES : slender cylindric to slightly allantoid, (6.5-)7.5-10.5 x 2-2.5(-3) µm (Congo Red, Melzer's reagent), hyaline, non-amyloid and non-dextrinoid, smooth and thin-walled.

HABITAT : on rotten wood of branches and tree stems.

DISTRIBUTION : Papua New Guinea.

REMARK : the most closely related species seem to be *Microporus vernicipes* (Berk.) Kunt. and *Trametes allantospora* Corner (see table 2). The latter species is described from Papua New Guinea and have allantoid spores, although remarkably shorter.

Table 2.

	M. vernicipes	***T. allantospora***	***T. lunospora***
Pores (/mm)	6-7	10-12	5-8
Spores	cylindric	allantoid	slender cylindric to allantoid
(µm)	5-7x2-2.5	2.3-3x0.7-1	(6.5-)7.5-10.5x2-2.5(-3)

EXSICCATA :

EASTERN HIGHLANDS : H. MERVIELDE, HM/PNG/155, 29.08.1990, primary rain forest along river, alt. 60 m, way to Kamba - Kauris, 3.2 km beyond bridge. E. QUANTEN, EQ 824, 09.10.1989, on rotten tree stem, rain forest, alt. 1750 m, Bantura, close to Ukarumpa; EQ 1037, 14.10.1989, on rotten branch, top of hill covered with rain forest, alt. 1800-1850 m, between Aiyura and Amamonta, ± 3 à 4 km E of S.I.L., Ukarumpa (Typus).

MOROBE PROVINCE : P. GOETGHEBEUR & W. VYVERMAN, 6250 (holotypus, GENT) + 6251, 30.08.1987, on rotten wood, montane rain forest, alt. 1840 m, c. 7°32'S 146°48'E, bridge over rivulets Elek + Kak: road under construction, 35 km,Wau - Garaina.

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This article is the first publication from our Ph.D-thesis concerning the polypores s.l. of Papua New Guinea (1993). This revision will be published in 1995.

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ENTOLEUCA MAMMATA COMB. NOV. FOR *HYPOXYLON MAMMATUM* AND THE GENUS *ENTOLEUCA*

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ABSTRACT

The genus ***Entoleuca*** is resurrected, with ***E. callimorpha*** as the type species. ***Hypoxylon mammatum***, a devastating pathogen of ***Populus tremuloides*** and some other angiospermous tree species, is moved to ***Entoleuca***. Several other potential taxa of ***Entoleuca*** are discussed.

Key Words: ***Entoleuca***, ***Hypoxylon***, ***Rosellinia***, systematics

Hypoxylon mammatum (Wahlenberg: Fr.) P. Karst., long cited as ***H. mammatum*** (Wahlenberg) J. H. Miller, is a serious pathogen of ***Populus tremuloides*** Michx. and a number other species of ***Populus*** L., ***Alnus*** Mill., ***Salix*** L., ***Betula*** L., and other genera. Reference to Miller (1961) shows a number of names placed into synonymy under ***H. mammatum***. Some of these, including ***H. pruinatum*** (Klotzsch) Cooke, ***H. morsei*** Berk. & M. A. Curtis, and ***H. blakei*** Berk. & M. A. Curtis, have been considered as host-specific species. French et al. (1969) cross-inoculated isolates from ***Populus***, ***Alnus***, and ***Salix*** species among species of these three genera and showed that some degree, perhaps high, of host specificity exists. However, dimensions of ascospores and perithecia among collections from various hosts did not indicate distinctive morphological differences and they thus concluded that Miller (1961) was justified in his concept of ***H. mammatum*** (French et al., 1969). They believed that further work might indicate pathological variants or *formae speciales* within ***H. mammatum*** (French et al., 1969). Based on this study and our own observations we presently accept Miller's concept (1961) of the species. However, we are convinced that ***H. mammatum*** is not a ***Hypoxylon*** Bull. as understood by us. It has been convenient to refer to the fungus as a ***Hypoxylon*** because of its long acceptance in the genus and because of its formal treatment in Miller's monograph (1961). ***Hypoxylon***, as comprehended by Miller (1961), is a heterogenous assemblage. In recent years large numbers of taxa have been removed from ***Hypoxylon*** to other genera, including ***Biscogniauxia*** Kuntze (Pouzar, 1979), ***Camillea*** Fr. (Laessøe et al., 1989), and ***Nemania*** Gray (Pouzar, 1985). There remain, however, other taxa that should be removed from ***Hypoxylon***. We are preparing a revision of ***Hypoxylon*** *sensu stricto* that hopefully will supersede Miller's treatment (1961). In this endeavor we have examined hundreds of type, authentic, and other specimens of putative ***Hypoxylon*** species. We concluded that ***Hypoxylon*** should be restricted to taxa having all or most of the following features: 1. stromata that are colored at some stage of their development and yield a colored pigment --- characteristic for the taxon --- in potassium hydroxide; 2. a germ slit on the convex side of the ascospore; 3. an immature ascospore that does not bear a cellular appendage; 4. an ascus apical apparatus that is usually broader than tall and often reduced to a disc or plate; 5. an ascospore perispore that dehisces in KOH; 6. a stroma that is waxy to woody or with a carbonaceous layer that surrounds perithecia in section ***Annulata*** (Ju and Rogers, unpublished); 7. and an anamorph referable to ***Nodulisporium*** Preuss. Many of the taxa that we accept in ***Hypoxylon*** have all of these features and all accepted taxa have most of them. Moreover, most ***Hypoxylon*** species appear to be, at most, weak parasites. The most variable interspecific character is the dehiscence of the ascospore perispore in KOH. We accept ***H fragiforme*** (Pers.: Fr.) J. Kickx fil. as the type species of the genus.

Hypoxylon mammatum is not a ***Hypoxylon*** in the above definition of the genus. It has a very carbonaceous stroma that overlies and partially encases mature perithecia (Rogers and Berbee, 1964); it lacks potassium hydroxide-extractable pigments. The ascospore germ slit is usually on the concave side of ascospores that are inequilateral; the perispore is rudimentary and not removed in potassium hydroxide. The immature ascospore bears a cellular appendage. The ascus apical apparatus is massive, conspicuously higher than broad. The anamorph in nature is usually borne upon bark-rupturing pillars or specialized synnemata (Rogers and Berbee, 1964) and is referable to ***Geniculosporium*** Chesters & Greenhalgh. Griffin et al. (1992) have pointed out that ***Nodulisporium*** and ***Geniculosporium*** morphologies can be found in cultures of ***H. mammatum***, but indicated that the latter was more prevalent. Distinctions between ***Geniculosporium*** and ***Nodulisporium*** are not always absolute, as noted by Greenhalgh and Chesters(1968). We accept ***Geniculosporium*** as the anamorph of ***H. mammatum***, as do Petrini and Müller (1986) and others. ***Geniculosporium*** is correlated with other genera that have features in common with ***H. mammatum*** and seem strongly related to it, e.g., ***Nemania*** and ***Rosellinia*** De Not.

A fungus very similar to ***H. mammatum*** was described as ***Entoleuca callimorpha*** Syd. (Sydow and Petrak, 1922). Examination of type material of this fungus convinces us that ***H. mammatum*** could and should be transferred to ***Entoleuca*** Syd. Pouzar (1985) suggested the availability of ***Entoleuca*** for ***H. mammatum*** and Laessøe and Spooner (1994) and Laessøe (1994) agreed, but considered ***Entoleuca*** to be a synonym of ***Rosellinia***. They did not, however, examine type material of ***E. callimorpha***. Our examination convinces us that ***Entoleuca*** is not a ***Rosellinia*** and, indeed, is worthy of generic status.

We do not consider ***H. mammatum*** to be a ***Rosellinia*** for the following reasons. First, the development differs from that of ***Rosellinia*** species. In most ***Rosellinia*** species perithecial stromata develop in a subiculum that sometimes also bears the anamorph. In ***Rosellinia mirabilis*** (Berk. &

Broome) Y.-M. Ju & J. D. Rogers [≡ **Astrocystis mirabilis** Berk. & Broome] the teleomorph develops beneath the **Acanthodochium** Samuels, J. D. Rogers, & Nagas. state, displacing it (Diehl, 1925; Ju and Rogers, 1990). In a number of other **Rosellinia** species the teleomorph is associated with coremia as well as with a subiculum. In **Hypoxylon mammatum**, however, no subiculum is present. The teleomorph is initiated in the bases of specialized coremioid pegs that break bark overlying them (Rogers and Berbee, 1964). As far as we are aware there is not a comparable developmental sequence in **Rosellinia**. Moreover, stromata of **H. mammatum** usually contain more than one perithecium, whereas a cardinal defining character of **Rosellinia**, in our opinion, is the uniperitheciate stroma. Finally, **Hypoxylon mammatum** is a virulent bark pathogen of apparently vigorous trees, whereas most **Rosellinia** species seem to be facultative parasites of roots of stressed or senescent hosts. We do not have detailed developmental data on **Entoleuca callimorpha**, but the general pattern seems identical to **H. mammatum**. We thus consider **H. mammatum** to represent the second species of **Entoleuca** (see later). Placing **H. mammatum** into **Entoleuca** allows the use of an extant genus and, thus, does not require the erection of a new genus. If fresh collections of **E. callimorpha** were to become available and be shown to be biologically different from **H. mammatum**, it is our opinion that a new genus would be required for the latter.

The affinities of **Entoleuca** are with **Nemania** S. F. Gray, **Ustulina** Tul. & C. Tul., **Stilbohypoxylon** Henn., **Penzigia** Sacc., and **Rosellinia**. These genera are characterized by white stromatal flesh that initially encases the perithecia, its development varying from scanty to robust among various taxa. In many taxa the white flesh darkens or deteriorates during perithecial maturity. The anamorph types of all of these genera (including those **Penzigia** species that should be reassigned to **Xylaria** Hill *ex* Schrank) are **Geniculosporium** or with **Geniculosporium**-like features.

Entoleuca Syd. *apud* Syd. & Petr., Ann. Mycol. 20: 186. 1922.
Type species: **E. callimorpha** Syd.

The genus has the general characteristics of the two accepted species (see below). Sydow speculated that **Spirogramma** Ferd. & Winge is related to **Entoleuca**, differing in having more numerous perithecia and in having spiral ascospore germ slits (Sydow and Petrak, 1922). He likewise believed that **Hypoxylon leucocreas** Berk. & Ravenel, known to him only from the description, is an **Entoleuca**. Cannon (1987) studied **Spirogramma** and concluded the type species, **S. boergesenii** Ferd. & Winge, is a penzigioid **Xylaria**, **X. boergesenii** (Ferd. & Winge) P. Cannon. He believed this fungus to be the same as **Hypoxylon conostomum** (Mont.) Mont. *sensu* J. H. Miller. We are presently undecided about the ultimate disposition of this fungus. Miller (1961) synonymized **H. leucocreas** with **Xylaria frustulosa** (Berk. & M. A. Curtis) Cooke. We have examined an isotype [U.S.A. SOUTH CAROLINA: Aiken, on blackened decorticated wood, date unknown, *H. W. Ravenel 1706* (FH, as **Sphaeria leucocreas** Berk. & Ravenel, *ined.*)]

and reaffirm Miller's synonymy. Sydow also believed that ***Nummularia repandoides*** Fuckel, a ***Biscogniauxia*** Kuntze, is an ***Entoleuca*** based upon a soft white part of the interior stroma (Sydow and Petrak, 1922). In our opinion, there is no close relationship of this fungus with ***Entoleuca***.

Martin (1968) reduced ***Entoleuca*** to a section of ***Hypoxylon*** which embraced a number of taxa mostly now considered to belong to ***Nemania*** or ***Rosellinia***.

Entoleuca callimorpha Syd. *apud* Syd. & Petr., Ann. Mycol. 20: 186. 1922.
FIGS. 1 & 2

Stromata more or less orbicular in outline, up to 5 mm diam, containing one to several perithecia, externally at first white, becoming dull black as the pruinose layer wears off; interior white surrounding perithecia. Stromata overlying and partially encasing perithecia hard to very hard at maturity. Host tissue, in which stromata partially embedded, whitened and somewhat resembling stromatal tissue. Stromata erumpent by raising and breaking bark periderm. Perithecia globose to somewhat elongated, 0.8-1.0 mm diam. Ostioles coarsely papillate. Asci eight-spored, long-stipitate, the spore-bearing part 85-110 x 11-13 μm *fide* Sydow (in Sydow and Petrak, 1922); ascus apical ring bluing in Melzer's reagent, urn-shaped, 3.7-4.4 μm broad x 4.4-5.9 μm high. Ascospores brown, one-celled, smooth, ellipsoid to ellipsoid-inequilateral, with narrowly rounded or broadly rounded ends, (14.5-)17.5-20.5(-22.0) x (6.5-)7.0-9.5 μm, with germ slit straight to oblique, full-length or slightly less, usually on concave side when spore inequilateral. Paraphyses numerous and narrow, 2-3 μm diam. Anamorph unknown.

SPECIMENS EXAMINED. U.S.A. COLORADO: Palm Lake, on ***Sorbus***, 14-X-1917, *E. Bethel* (W 17007). MONTANA: Drummond, on Red Astrakan apple tree, 28-VI-1918, *J. A. Hughes*, sent to *Sydow* by *J. R. Weir* as *7945*, *F. Petrak* herb. *9325* (BPI 594120, ISOTYPE; W 20165, HOLOTYPE); sine loco, sine anno, *J. R. Weir*, ? *Sydow 1343* (W 22319).

Martin (1967) and Miller (1961) believed ***E. callimorpha*** to be a synonym of ***H. mammatum***, the latter seeing the essentially immature isotype material at BPI. Material that we consider to be holotype at W has abundant mature ascospores, but is devoid of intact asci. The ascospore dimensions are close to those cited in Sydow and Petrak (1922). Ascospores of some collections of ***H. mammatum*** examined were 22.0-28.0 x 9.0-9.5(-11.0) μm. Miller (1961) gives them as 20-33 x 9-12 μm and Petrini and Müller (1986) give

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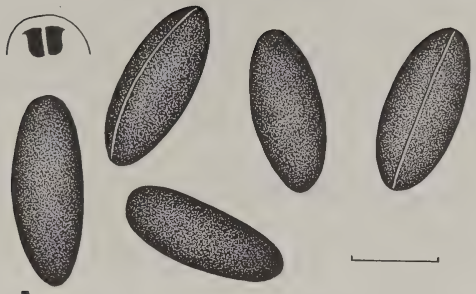
FIGS. 1, 2. ***Entoleuca callimorpha***. 1. Ascus tip and ascospores. Scale bar represents 10 μm. 2. Diagrammatic representation of stromatal tissue and perithecium at various developmental stages. A. White soft stromatal tissue surrounded by black, carbonaceous stromatal tissue. B. Incipient perithecium overlain with a black, carbonaceous, clypeoid stroma developing in the white stromatal tissue. C. Growth of perithecium accompanied by horizontal extension of clypeoid stroma. a: white, soft stromatal tissue. b: black, carbonaceous stromatal tissue. c: peridermal tissue of host. d: bark tissue of host. p: perithecium.



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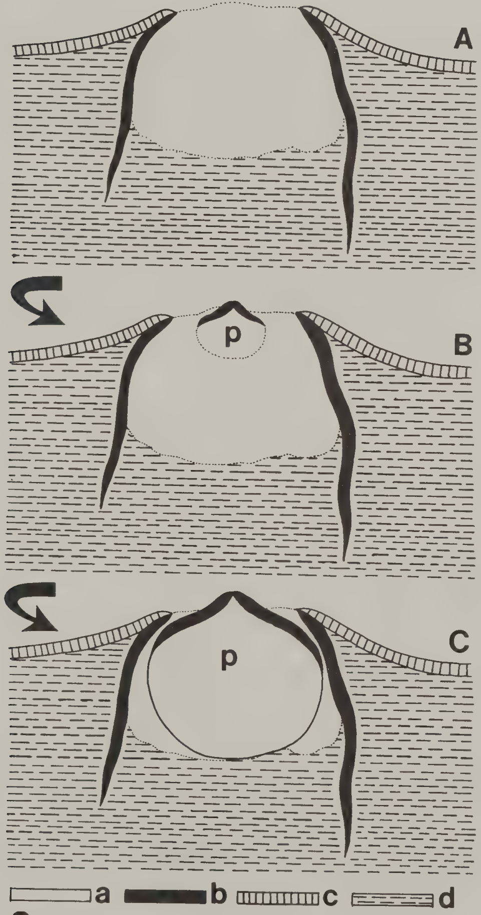

2

them as 19-27 x 7-10(-12) µm. In any case, ascospores of ***H. mammatum*** average much larger than those of ***E. callimorpha***. Moreover, the ascospores of ***H. mammatum*** are more or less rectangular in outline.

As far as we know, ***Entoleuca callimorpha*** has not been collected in recent times and never cultured. The bark-rupturing pegs typical of the following species were not seen in these collections.

Entoleuca mammata (Wahlenberg: Fr.) J. D. Rogers *et* Y.-M. Ju, *comb. nov.*
Basionym: ***Sphaeria mammata*** Wahlenberg: Fr., Fl. Suec., p. 1003. 1826.
≡ ***Hypoxylon mammatum*** (Wahlenberg: Fr.) P. Karst., Not. Sällsk. Fauna Fl. Fenn. Förh. 8: 212. 1882 (1886). (Original not seen. Taken from *Index of Fungi* 5 (20), July 1990).
(For other synonyms and potential synonyms, see Miller, 1961, and Petrini and Müller, 1986).

The teleomorph of ***E. mammata*** is well-described by Miller (1961) and Petrini and Müller (1986). Cultures and the anamorph in culture are described by Petrini and Müller (1986). The development of the teleomorph and the anamorph in nature are treated by Rogers and Berbee (1964).

KEY TO GENERA ALLIED WITH ***ENTOLEUCA***

1. Stromata typically developing within host bark, becoming erumpent. Bark-rupturing pegs present in one species (probably both) ..... ***Entoleuca***
1. Stromata typically developing upon host bark or wood, not commonly erumpent. Bark-rupturing pegs unknown 2

2. Stromata typically uniperitheciate 3
2. Stromata typically multiperitheciate 4

3. Stromata usually associated with a subiculum and sometimes with synnemata. Synnematal remnants usually not adhering to stromata ....***Rosellinia***
3. Stromata not associated with subiculum. Perithecial stromata initiated within conical synnemata or in close proximity. Synnematal remnants adhering to stromata as spines or warts ....***Stilbohypoxylon***

4. Synnemata sometimes seen in nature and often in culture. In part, pulvinate or atypical states of ***Xylaria***. Probably an untenable genus. ....***Penzigia***
4. Synnemata not ordinarily produced in nature or in culture................. 5

5. Stromata usually massive (exceeding 1 cm in diameter and 0.5 cm in thickness), becoming hollow with age... ***Ustulina***
5. Stromata usually small (seldom attaining 1 cm diameter and/or 0.2 cm in thickness), some taxa becoming hollow with age ....***Nemania***

ACKNOWLEDGMENTS

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MYCOTAXON

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NEW SPECIES OF *HAPLOTRICHUM* AND *SOLICORYNESPORA* FROM CUBA

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ABSTRACT

Two new hyphomycetes from Cuba, *Haplotrichum perseae* anam. sp. nov., found on dead aerial branches of live *Persea americana* and *Solicorynespora kendrickii* anam. sp. nov., found on leaf litter of *Theobroma cacao* , are described and illustrated. The former has peculiar conidia with a verrucose, thick (tunica-like) outerwall, and the latter is distinguished by hairy conidiophores with a radially lobed basal cell and cylindrical to ellipsoid, 2–4 euseptate conidia with brown central cells and pale brown ends.

Key Words: ***Haplotrichum, Solicorynespora***, Cuba, hyphomycetes, litter, systematics, tropical fungi, wood.

RESUMEN

Se describen e ilustran dos nuevos hifomicetos de Cuba; *Haplotrichum perseae* anam. sp. nov. hallada en ramas aéreas muertas de un árbol vivo de *Persea americana* y *Solicorynespora kendrickii* anam. sp. nov. hallada sobre hojas podridas caídas de *Theobroma cacao* . La primera posee extraños conidios con la pared exterior gruesa y verrucosa parecida a una túnica envolvente y la última se distingue por sus conidióforos con la base radialmente lobulada y conidios de cilíndricos a elípticos, con 2–4 septos y con las células centrales de color pardo y los extremos de color pardo pálido.

TAXONOMIC PART

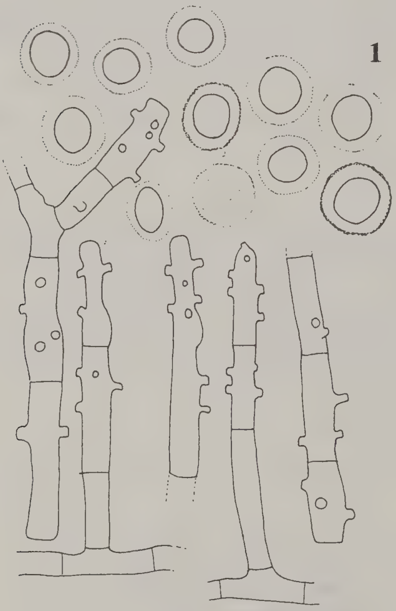
Haplotrichum perseae Castañeda Ruíz anam. sp. nov. Figs. 1, 3 f-h
Etym.: Latin *perseae* referring to its habitat

Ad fungos conidiales hyphomycetes pertinens. ***Coloniae*** *caespitosae usque gossypinae, effusae, primo albae deinde pallide brunneae. Mycelium plerumque superficiale et aliquot in substrato immersum, ex hyphis septatis perramosis, laevibus, dilute brunneis vel subhyalinis, 4–7 µm diam.* ***Conidiophora*** *conspicua, mononematosa, erecta, interdum prostrata, recta vel flexuosa, septata, 200 x 4–6 µm, simplicia, hyalina vel subhyalina.* ***Cellulae conidiogenae*** *polyblasticae, sympodiales, integratae, terminales et intercalares, denticulatae, cum denticulis cylindricis, conspicuis, 2–3 µm longis praeditae.* ***Conidia*** *globosa usque subglobosa, unicellularia, solitaria, acropleurogena, subhyalina vel hyalina, 11–14 µm diam, microverrucosa, semper cum parietibus latis, aspectibus tunicatis praedita. Teleomorphosis ignota.*

Conidial fungi, hyphomycetes. **Colonies** caespitose to cottony, effuse, firstly white, pale brown thereafter. Mycelium mostly superficial, composed of septate, branched, smooth, 4–7 µm diam, pale brown to subhyaline hyphae. **Conidiophores** differentiated, mononematous, erect, sometimes prostrate, straight or flexuous, septate, 200 x 4–6 μm, simple, hyaline to subhyaline. **Conidiogenous cells** polyblastic, sympodial, integrated, terminal and intercalary, denticulate with cylindrical, 23 μm long, evident denticles. **Conidia** globose to subglobose, one-celled, solitary, acropleurogenous, hyaline to subhyaline, 11–14 μm diam, always with a very thick and microverrucose outerwall resembling a tunica. Teleomorph unknown.

Habitat: On dead branches of a living tree of *Persea americana,* Santiago de las Vegas, Cuba, 13 July 1994.
Holotype: INIFAT, C94/65, C. Habana. Cuba.
Isotype: MUCL 39187.

The species of *Haplotrichum* Link are anamorphs of *Botryobasidium* Donk (Holubová–Jechová 1976, 1980) and were considered for a long time under the names *Oidium* (Linder 1942) and *Acladium* (Ellis 1976). Among the previously described species, only *Haplotrichum sphaerosporum* (Linder) Hol.–Jech. 1976, *H. tenerum* (Sunstime) Hol.–Jech. 1976 and *H. curtisii* (Berk.) Hol.–Jech. 1976 somewhat resemble *H. perseae* because all of them have globose conidia of a similar diameter. However, conidia with such a characteristic outerwall are only present in *H. perseae*.



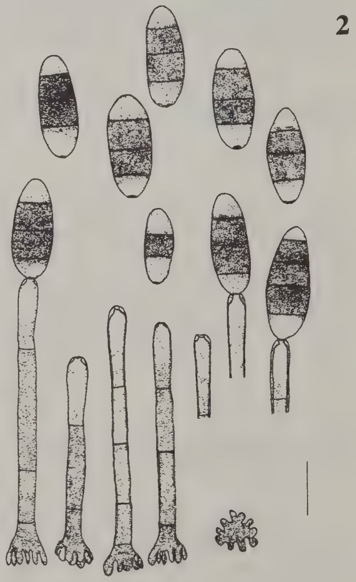
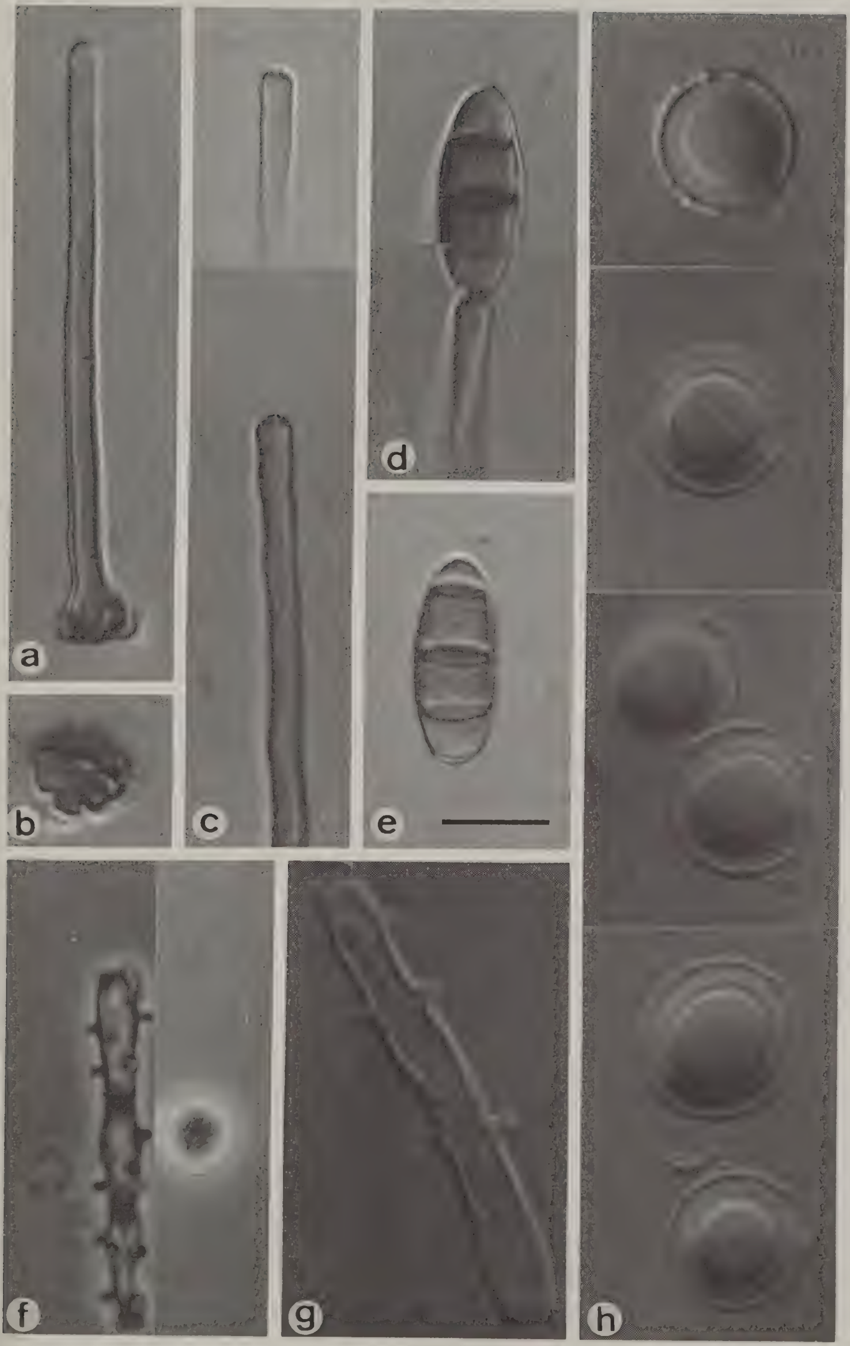


Fig. 1. ***Haplotrichum perseae*** (INIFAT C94/65). Condiophores, conidiogenous cells and conidia. Fig. 2. ***Solicorynespora kendrickii*** (INIFAT C94/34). Conidiophores, conidiogenous cells and conidia. Bar = 10 μm

Fig. 3. ***Solicorynespora kendrickii*** (INIFAT C94/34) a) conidiophore; b) basal cell; c) conidiogenous cells; d-e) conidia. ***Haplotrichum perseae*** (INIFAT C94/65) f-g) conidiogenous cells; h) conidia. Bar = 10 μm.


a
b
c
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g
h

Solicorynespora kendrickii Castañeda Ruíz anam. sp. nov. Figs. 2, 3 a-e
Etym.: Latin *Kendrickii*, dedicated to Bryce Kendrick one of the foremost mycologists in the world.

Ad fungos conidiales, hyphomycetes pertinens. ***Coloniae*** *effusae, pilosae, amphigenae, brunneae. Mycelium partim superficiale et partim in substrato immersum, ex hyphis septatis, ramosis, laevibus, brunneis, 2–3 µm diam, compositum.* ***Conidiophora*** *conspicua, mononematosa, cylindrica, 2–6 septata, simplicia, levia, brunnea ad basim et pallide brunnea ad apicem, 40–120 x 5–8 µm, e basibus radiatim lobatis oriunda.* ***Cellulae conidiogenae*** *monotreticae, terminales, clavatae, in conidiophoris incorporatae, subhyalinae, 6–14 x 3–3.5 µm.* ***Conidia*** *cylindrica usque ellipsoidea, 2–4 euseptata, solitaria, acrogena, cicatricata ad basim, levia, interdum leviter verrucosa, sicca, cum cellulis centralis brunneis et utrimque subhyalinis vel pallide brunneis, 15–26 x 6–7 µm. Teleomorphosis ignota.*

Conidial fungi, hyphomycetes. **Colonies** spreading, hairy, amphigenous, brown. Mycelium superficial and immersed. Hyphae septate, branched, smooth-walled, brown, 2–3 µm diam. **Conidiophores** differentiated, mononematous, cylindrical, 2–6 septate, simple, smooth, brown at the base, pale brown towards the apex, 40–120 µm tall, arising from a radially lobed basal cell 5–8 µm diam. **Conidiogenous cells** monotretic, terminal, clavate, integrated, pale brown 6–14 x 3–3.5 µm. **Conidia** cylindrical to ellipsoid, 2–4 euseptate, solitary, acrogenous smooth-walled, sometimes slightly verrucose, dry, 15–26 x 6–7 µm, with central cells brown and ends subhyaline, with a conspicuous dark scar at the base. Teleomorph unknown.

Habitat: On decaying fallen leaves of ***Theobroma cacao***, INIFAT campus. Santiago de las Vegas, Cuba, Feb. 16, 1994.
Holotype: INIFAT C94/34, R. F. Castañeda, C. Habana, Cuba.
Isotype: CBS-Herb.

The genus *Solicorynespora* Castañeda Ruíz and Kendrick (1990) comprises species with monotretic conidiogenous cells, and with euseptate, solitary conidia uually with a verrucose outerwall. Among the previously described species of *Solicorynespora* none resemble *S. kendrickii* except *S. pseudolmediae* (Castañeda Ruíz) Castañeda Ruíz & Kendrick (1990), but its conidia are 3–5 septate and obclavate.

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SOME NEW CONIDIAL FUNGI FROM CUBA

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ABSTRACT

Amoenomyces catenosporus anam. gen. et sp. nov. found on bark of ***Coccoloba uvifera*** and ***Nakataea cylindrospora*** anam. sp. nov. from decaying leaf, are described and illustrated.

Key words: ***Amoenomyces, Nakataea***, tropical fungi, systematics.

TAXONOMIC PART

Amoenomyces Castañeda, Saikawa & Hennebert anam. gen. nov.
Etym.: L. ***Amoeno***-, meaning nice and attractive; -***myces***, refers to fungi.

Ad fungos conidiales, hyphomycetes pertinens. ***Coloniae*** *effusae, brunnea usque nigrae. Mycelium partim superficiale et partim immersum.* ***Conidiophora*** *conspicua, mononematosa, singula usque fasciculata, simplicia vel ramosa, septata, brunnea usque nigra.* ***Cellulae conidiogenae*** *polytreticae, sympodiales, terminales vel intercalares, integratae, cum poris conspicuis in locis conidiogenesis.* ***Conidia*** *dictyoseptata, sympodialiter blastocatenata, obovoidea, obclavata, clavata vel pyriformia, brunnea usque atrobrunnea, per poris orienta.*

Species typica: ***Amoenomyces catenosporus*** *anam. sp. nov.*

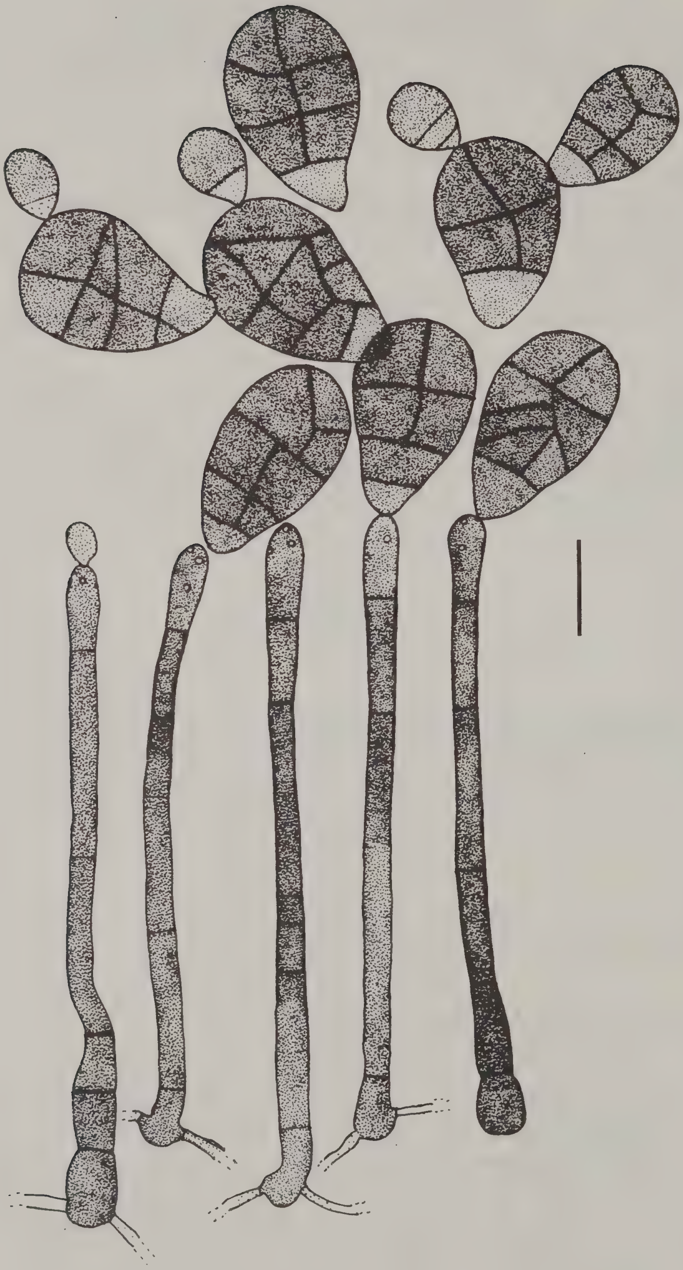

Fig. 1.- ***Amoenomyces catenosporus*** (INIFAT C94/192). Conidiophores, conidiogenous cells and conidia (bar = 10 μm)

Conidial fungi, hyphomycetes. **Colonies** spreading, brown to black. Mycelium superficial and immersed. **Conidiophores** differentiated, mononematous, singly or fasciculate, simple or branched, septate, brown to black. **Conidiogenous cells** polytretic, sympodial, terminal or intercalary, integrated, with distinct, circular pores at the conidiogenous loci. **Conidia** dictyoseptate, sympodially acropetal extending chains, obovoid, obclavate, clavate or pyriform, brown to dark brown, arising through pores at the conidiogenous cells.

Amoenomyces catenosporus Castañeda, Saikawa et Hennebert anam. sp. nov. Figs.1,2

Ety.: L. ***cateno***-, in chains ; -***sporus***, refers to conidia.

Ad fungos conidiales, hyphomycetes pertinens. ***Coloniae*** *effusae, pilosae, nigrae. Mycelium partim superficiale et partim in substrato immersum, ex hyphis septatis, laevibus, pallide brunneis usque brunneis, 1-2 μm diam compositum.* ***Conidiophora*** *conspicua, mononematosa, brunnea, eramosa, erecta, flexuosa, 4-12 septata, cylindrica, plerumque inflata ad basim ex unica cellula ex hyphis oriunda; levia, usque 250 μm longa et 2,5 - 3,5 μm crassa ad basim.* ***Cellulae conidiogenae*** *polytreticae, sympodiales, saepissime terminales, raro intercalares, integratae, cylindricae usque clavatae, brunneae, 12-22 x 2,5-3 μm, cum poro manifesto praedita.* ***Conidia*** *dictyoseptata obovoidea usque pyriformia, globosa, interdum leviter curvata ad basim, sympodialiter blastocatenata, levia, sicca, brunnea ad basim, atrobrunnea ad apicem, 15-26 x 12-16 μm, cum poro basale praedita. Teleomorphosis ignota.*

Typus: *In cortices emuortis* ***Coccolobae uviferae***, Cabo de San Antonio, Pinar del Rio, Cuba. **Legit**: R.F. Castañeda and M. Saikawa, Aug.1994. **Holotypus**: INIFAT C94/192, in INIFAT herbarium Havana, Cuba. **Isotypus**: MUCL n° 39153 in MUCL herbarium, Louvain-la-Neuve, Belgium et CBS 239.95 in CBS herbarium Baarn, The Netherlands.

Conidial fungi, hyphomycetes. **Colonies** spreading, hairy, black. Mycelium superficial and immersed. Hyphae septate, smooth-walled, pale brown to brown, 1-2 μm diam. **Conidiophores** differentiated, mononematous, unbranched, brown, upright, flexuous, 4-12 septate, cylindrical, inflated at the base, commonly arising from one cell of the hyphae, smooth, up to 250 μm long and 2,5-3,5 μm wide at the base. **Conidiogenous cells** polytretic, sympodial, terminal, rare intercalary, integrated, cylindrical to clavate, brown, 12-22 x 2,5-3 μm; with evident pores. **Conidia** dictyoseptate, obovoid to pyriform, globose, sometimes slightly curved at the base, in branched acropetal chains, smooth-walled, dry, base brown, apex dark brown, 15-26 x 12-16 μm, with a basal pore.

Specimen type: On bark of ***Coccoloba uvifera***, Cabo de San Antonio, Pinar del Río, Cuba, R.F. Castañeda and M. Saikawa; Aug. 8, 1994. **Holotype**: INIFAT C94/192, in INIFAT herbarium Havana, Cuba. **Isotypes**: MUCL n° 39153 in MUCL herbarium, Louvain-la-Neuve, Belgium and CBS 239.95 in CBS herbarium Baarn, The Netherlands. **Living cultures from the type material deposited in fungus**

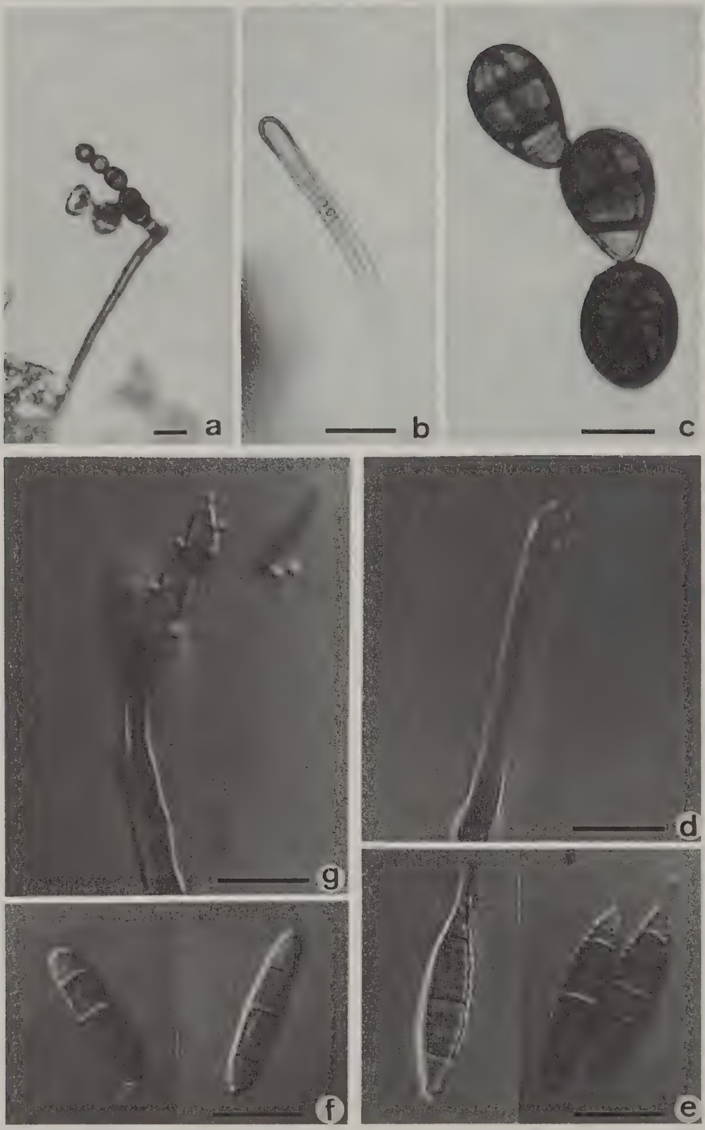

Fig. 2.- ***Amoenomyces catenosporus*** (INIFAT C94/192). a) conidiophores and conidia in chain (bar = 10 μm); b) conidiogenous cells with pores; c) conidia in chain (bars = 10 μm). ***Nakatea fusiformis*** (INIFAT C94/139); d-e) conidiogenous cell and conidia (bars = 10 μm). ***Nakatea cylindrospora*** (INIFAT C94/182); f-g) conidiogenous cells and conidia (bars = 10 μm).

collections: INIFAT C94/192 Havana, Cuba; MUCL 39153, Louvain-la-Neuve, Belgium and CBS 239.95 Baarn, The Netherlands.

The conidial ontogeny in ***Diplococcium*** Grove (Ellis 1971, 1976) is similar that in ***Amoenomyces***. Both have polytretic conidiogenous cells with minute conidiogenous loci. In addition its show circular pores through small channels in the thick wall and catenate conidia. However the conidia are never dictyoseptate in ***Diplococcium***. This type of conidia are present in ***Alternaria*** Nees: Fr. (Ellis 1971, 1976), but in this genus the conidiogenous cells are cicatrized. Also similar conidiogenesis show ***Spadicoides*** Hughes (Ellis 1971, 1976), but conidiogenous cells are intercalary and terminal such as in ***Diplococcium***, but conidiogenous cells in ***Amoenomyces*** are terminal with conidiogenous loci restricted at the apex with sympodial development. ***Ulocladium*** Preuss (Ellis 1971) resemble slightly ***Amoenomyces***, both genera have dictyoseptate conidia, obvoid to pyriform, but in the former the conidiogenous cells are also, intercalary and conidiogenous locis cicatrized and dark. ***Amoenomyces*** could be compared with ***Holubovaea*** Mercado(1983), conidiogenous locis in both genera are very small pore distributed sympodially at the apex, but conidia in ***Holubovaea*** are not dictyoseptate and not catenate.

Nakataea cylindrospora Castañeda, Saikawa et Hennebert anam. sp. nov. Figs.2,3.

Ad fungos conidiales, hyphomycetes, pertinens. ***Coloniae*** *effusae, hypophyllae, pilosae, brunneae. Mycelium partim superficiale et partim in substrato immersum, ex hyphis septatis, ramosis, laevibus, brunneis, 1-2 μm diam compositum.* ***Conidiophora*** *conspicua, mononematosa, eramosa, erecta, recta vel flexuosa, 1-8 septata, levia, brunnea, 40-120 x 6-7 μm ex cellulis globosis, 8-19 μm diam, atrobrunneis, laevibus,confluentis, aspectibus reticulatis oriunda.* ***Cellulae conidiogenae*** *polyblasticae, sympodiales, terminales et intercalares, integratae, 10-20 x 4-5 μm, denticulatae, cum denticulis conspicuis, 1-2 μm longis praeditae.* ***Conidia*** *cylindrica, interdum navicularia, rotundata ad apicem, obtusa et fimbriata ad basim plerunque 3-septata, sicca, verrucosa, cellulae utrinque dilute brunneae vel subhyalinae, cellulae centrales brunneae, non catenata, 16-19 x 3,5-4 μm.Teleomorphosis ignota.*

Typus: *In foliis putridis* ***Nectandrae antillanae***, Cabo de San Antonio, Pinar del Río, Cuba. **Legit**: R.F. Castañeda and M. Saikawa; Aug. 9 1994. **Holotypus**: INIFAT C94/182,in INIFAT herbarium, Havana, Cuba. **Isotypus**: MUCL 39178 in MUCL herbarium, Louvain-la- Neuve, Belgium.

Conidial fungi, hyphomycetes. **Colonies** spreading, hypophyllous, hairy, brown. Mycelium partly superficial and partly immersed. Hyphae septate, branched, smooth-walled, brown, 1-2 μm diam. **Conidiophores** differentiated, mononematous, unbranched, erect, straight or flexuous, cylindrical, 1-8 septate, smooth, brown, 40-120 x 6-7 μm, arise from globose, 8-19 μm diam, dark brown, smooth, confluent cells which forming an agglomerate of cells network-like. **Conidiogenous cells** polyblastic, sympodial, terminal intercalary, integrated, 10-20 x 4-5 μm, with conspicuous, 1-2 μm long denticles. **Conidia** cylindrical, sometimes navicular, rounded at the apex, obtuse and fimbriate at the base, 3-septate, dry, verrucose, pale brown or subhyaline at the

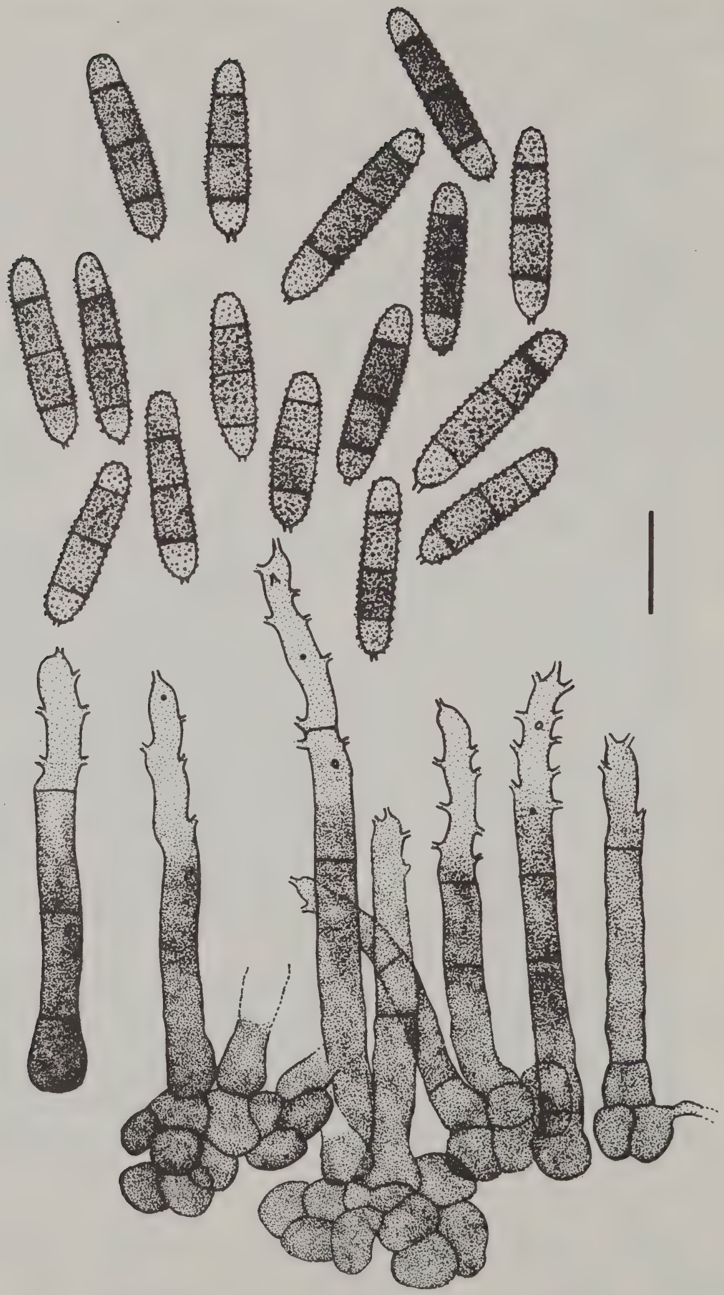

Fig. 3.- ***Nakataea cylindrospora*** (INIFAT C94/182) conidiophore, conidiogenous cells and conidia (bar = 10 μm).

ends central cells brown, not catenate, 16-19 x 3,5-4 μm.Teleomorph unknown.

Type: On rotten leaf of ***Nectandra antillana***, Cabo de San Antonio, Pinar del Río, Cuba, R.F. Castañeda and M. Saikawa, Aug. 9, 1994. **Holotype**: INIFAT C94/182, in INIFAT herbarium, Havana, Cuba. **Isotype**: MUCL 39178 in MUCL herbarium, Louvain-la-Neuve, Belgium. **Living cultures from the type material deposited in fungus collections**: INIFAT C94/182 Havana, Cuba; MUCL 39178, Louvain-la-Neuve, Belgium.

Nakataea fusispora (Matsushima) Matsushima (Fig.2), (Matsushima, 1975; Castañeda and Kendrick 1990a; Mouchacca 1990) and ***Nakataea rarissima*** Castañeda et Kendrick (1990 b) are close related ***N. cylindrospora*** in pigmentation of the conidia but are clearly differentiated in shape, ornamentation of the outer wall and size of conidia. ***N. fusispora*** has conidia fusiform, with verrucose central cells and smooth ends (19) 25-34 x 4,8-6 μm, whereas ***N. rarissima*** has conidia obclavate to subfusiform, slightly constricted at the septa, smooth-walled, 19-25 (-28) x 3-5 μm sometimes with secondary conidium borned at the basal cell.

Other previously described species such as ***Nakataea sigmoidea*** Hara (Ellis 1971); ***Nakataea serpens*** Shearer & Crane (1979) and ***Nakataea curvularioides*** G. Arnold (Arnold & Castañeda 1987) are very different from ***Nakataea cylindrospora***.

KEY TO SPECIES OF *NAKATAEA*

1. Conidia smooth 2

1.' Conidia verrucose 3

2. Conidia narrow or obclavate, rostrate at the apex, 48-74 x 7,2-8,4 μm . . . . ***N.serpens***

2.' Conidia not rostrate at the apex 4

3. Conidia fusiform, (19-) 25-34 x 4,8-6 μm . . . . ***N. fusispora***

3.' Conidia cylindrical, 16-19 x 3,5-4 μm . . . . ***N. cylindrospora***

4. Conidia falcate or sigmoid 5

4.' Conidia obclavate to subfusiform, 19-25(-28) x 3-5μm . . . . . . ***N. rarissima***

5. Conidia falcate, 40-83 x 11-14 μm . . . . ***N. sigmoidea***

5.' Conidia sigmoid, 18-26 x 8-9,5 μm . . . . ***N. curvularioides***

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NOTES ON CONIDIAL FUNGI. IX. A NEW SPECIES OF *UBERISPORA* FROM CUBA

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ABSTRACT

Uberispora heteroseptata anam. sp. nov., a conidial fungus, found on a fallen, rotten leaf of *Nectandra coriacea* from Cuba, is described and illustrated. It is distinguished by the heteroseptate conidia with obtuse to hemispherical satellite cells which sometimes produce phialidic microconidia.

Key words: *Uberispora*, hyphomycetes, litter fungi, tropical fungi, systematics.

RESUMEN

Se describe e ilustra *Uberispora heteroseptata* anam. sp. nov. un hongo conidial, hallado sobre hoja podrida de *Nectandra coriacea* en Cuba. Se distingue por sus conidios heteroseptados con células satélites de obtusas a hemisféricas, las cuales algunas veces producen microconidios fialídicos.

Palabras clave: *Uberispora*, hyphomycetes, hongos tropicales, sistemática.

Uberispora heteroseptata Castañeda Ruiz, Guarro et Cano anam sp. nov. (Fig. 1,2)

Ad hyphomycetes pertinens. Coloniae effusae, pilosae, amphigenae, nigrae vel atrobrunneae. Mycelium plerumque in substrato immersum, et aliquot superficiale, ex hyphis septatis, breve ramosis, laevibus, brunneis, 1-2 μm diam compositum. Conidiophora conspicua, mononematosa, erecta, recta, 6-8 septata, eramosa, cylindrica, sinuata, levia, atrobrunnea ad basim, brunnea vel pallide brunnea ad apicem 175-300 x 12-15 μm lobata ad basim. Cellulae conidiogenae *monoblasticae, 6-11 proliferationibus repetiter percurrentes, in conidiophoris incorporatae; brunneae vel pallide brunneae.* *Conidia stellata, acrogena, solitaria, heteroseptata, sicca, levia, in universum 15-20 x 13-18 μm, ex cellulis 3 formarum composita: a) cellula basalis conico-truncata, dilute brunnea, interdum brunnea, 5-8 x 6-8 μm infra 2-3 μm crassa, interdum minute fimbriata; b) cellula centralis, globosa usque angularis, heteromorpha, atrobrunnea, saepe obscura ad septis, 9-12 x 10-12 μm. c) 2-5 cellulae laterales conicae, rotundae vel obtusae ad apicem, interdum leviter constrictae ad septo, pallide brunneae raro brunneae, 3-8 x 4-5 μm.* *Synanamorpha constantia ex cellulis apicalibus producentibus conidia blastica-phialidica, fusiformia, unicellularia, hyalina, levia, 3 μm longa, ex poris apicalibus, cum collo manifesto praedita. Teleomorphosis ignota.*

Hyphomycetes. Colonies spreading, hairy, amphigenous, black or dark brown. Mycelium mostly immersed, composed of septate, slightly branched, smooth, brown hyphae 1-2 μm diam. Conidiophores differentiated, mononematous, erect, straight, 6-8 septate, unbranched, cylindrical, walls wavy, smooth, dark brown and lobed at the base, brown to pale brown at the apex. Conidiogenous cells monoblastic, integrated, 6-11 proliferations, repeatedly percurrent, producing clearly visible annellations. Conidia stellate, acrogenous, solitary, heteroseptate, dry, smooth, 15-20 x 13-18 μm, composed of 3 parts delimited by darker septa: a) basal cell obconical, truncate, pale brown, sometimes brown, 5-8 x 6-8 μm, 2-3 μm wide below, often scar frilled; b) central cell globose to angular, dark brown, always dark at the septa, 9-12 x 10-12 μm; c) 2-5 lobes lateral, conical, rounded to obtuse at the apex, often with a middle septum, pale brown, sometimes brown, 3-8 x 4-5 μm. Synanamorph: Sometimes the peripheral cells become phialides with small collarettes, producing apical, blastic-phialidic, bacillar, one-celled, hyaline, smooth, 3 x 0.5 μm conidia.

Teleomorph unknown.

Holotype: INIFAT C93/247, on rotten leaf of *Nectandra coriaceae*, Pinar del Río, Cuba. April 22, 1993. R.F. Castañeda. Isotype: MUCL 39186, (Mycothèque Université Catholique de Louvain, Belgium).

The genus *Uberispora* Pirozynski & Hodges (1973) comprised two species, *U. simplex* (Ichinoe) Pirozynski & Hodges (1973) and *U. tropicalis* Bhat & Kendrick (1993). *U. simplex* has 1-2 slender conidiogenous branches and conidia with lateral and apical hyaline conical cells which sometimes produce phialoconidia. *U. tropicalis* has no apical cells, and the lateral ones have obtuse to rounded apices. *U. heteroseptata* differs from both those species because it has no branched conidiophores, and conidia are heteroseptate with lateral branches sometimes septate, obtuse to rounded at the apex and with a synanamorph occasionally present.

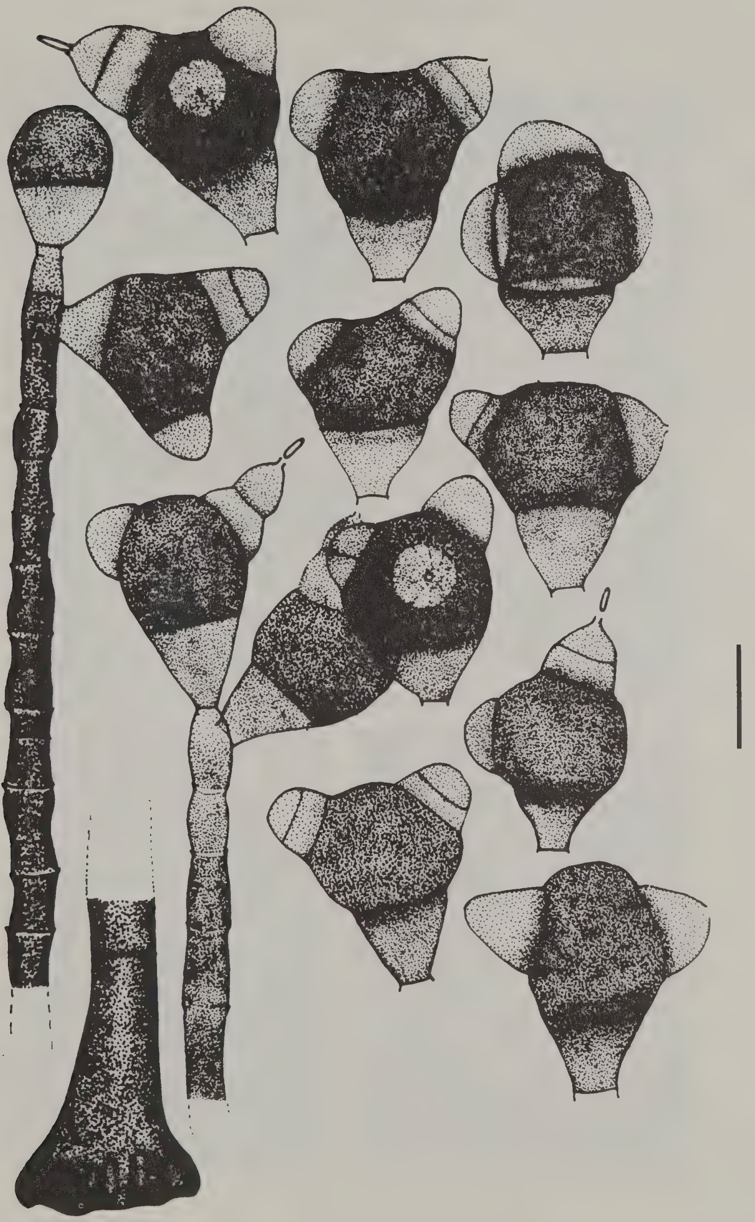

Fig.1- *Uberispora heteroseptata* (INIFAT C93/247). Conidiophores and conidia (bar =10 µm)

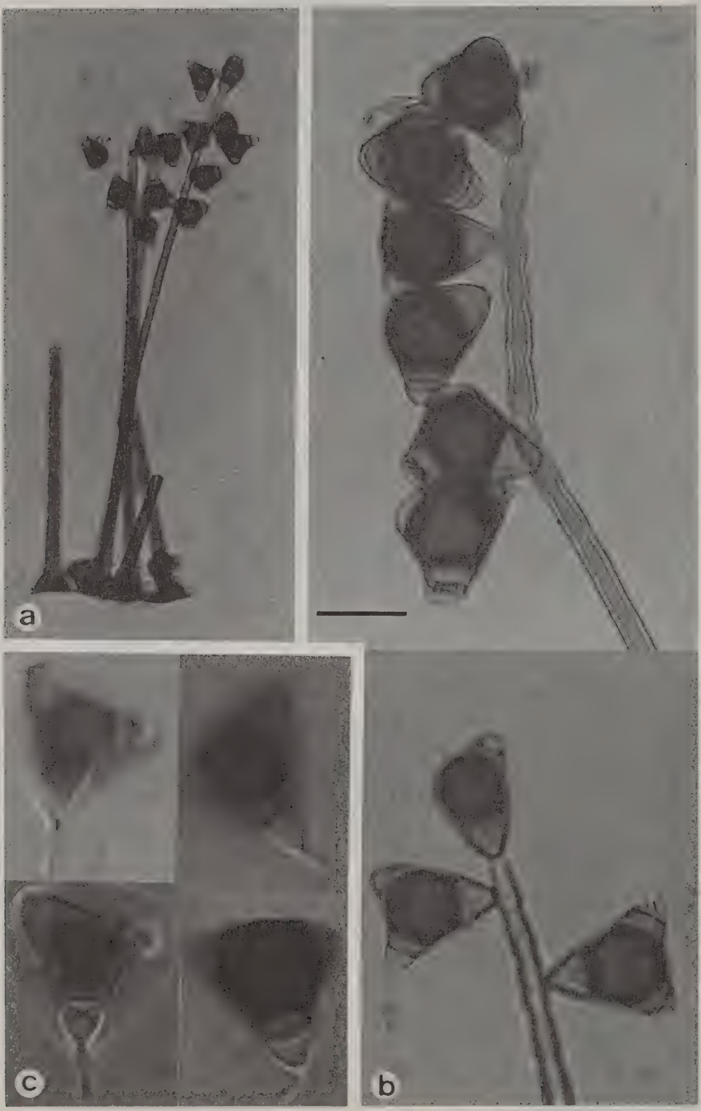

Fig. 2- *Uberispora heteroseptata* (INIFAT C93/247). **a,** conidiophores and conidia; **b,** conidiogenous cell proliferations and conidia; **c,** stellate conidia producing bacillar conidia (a, bar = 25 μm; b,c, bar = 10 μm)

KEY TO SPECIES OF *UBERISPORA*

1a.- Conidia with apical satellite cells; lateral cells pointed at the apex; basal cell 3-5 x 4-6 µm .... *U. simplex*
1b.- Conidia without apical satellite cells 2
2a.- Conidia not heteroseptate; lateral satellite never septate; basal cell 5-8 x 3-6 µm .... *U. tropicalis*
2b.- Conidia heteroseptate; lateral satellite often septate; basal cell 5-8 x 6-8 µm .... *U. heteroseptata*

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MORPHOLOGICAL, KERATIN COLONIZING AND DEGRADING CHARACTERS OF SOME KERATINOPHILIC FUNGI AND RELATED DERMATOPHYTES ISOLATED FROM KEOLADEO NATIONAL PARK, BHARATPUR

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ABSTRACT

Morphological, keratin colonizing and degrading characters of some keratinophilic fungi and related dermatophytes have been studied. Colonization of different substrates by fungi did not show any correlation with their morphological characters. However, it was possible to distinguish isolates on the morphological and biochemical basis as fungi with rhexolytically dehiscing conidia displayed similar enzyme-specificity in degrading chicken feathers while, *Gymnoascus subumbrinus* with schizolytically dehiscing conidia could not degrade it.

Key words: Pleomorphism, mating reactions, degradation, colonization, rhexolytic, schizolytic, floccose, velvety, echinulate, verruculose, ellipsoid, fusiform, arthroconidia, microconidia, macroconidia, aleurioconidia.

INTRODUCTION

Keratinophilic fungi and related dermatophytes are a group of Ascomycetes and Deuteromycetes of various morphology. Morphology, gross and microscopic has traditionally been the main criterion of classification (Van Oorschot, 1980; Kushwaha, 1983a). This is apparently based on the assumption that organisms regarded at species level have a shape and structure that enables them to be distinguished from one another. But the difficulty is sometimes increased in their identification by pleomorphism and poor sporulation.

Traditionally only a few non-morphological methods have been recognized as being effective in their identification *viz.* hair perforation tests, biochemical tests, serological tests and mating reactions (Griffin, 1960; English, 1963; Sekhon *et al.*, 1973; Polonelli and Morace, 1985). Recently diverse substrates have been shown to become colonized by many keratinophilic fungi and related dermatophytes and are being hydrolyzed intensively and specifically (Mc Donald, 1985; Sanyal *et al.*, 1985;

Kunert and Kasafirek, 1988; Singh *et al.*,1994). Keratin degradation involves rupturing the disulphide linkages between the peptide chains of keratin molecules. Within the group, enzymes able to break the disulphide bridge of keratin probably arose once and their presence among taxa should indicate a high level of relationship (Currah, 1985).

In order to make some headway towards understanding this clue, attempts have been made by a few workers to obtain basic information on the specificity of these enzymes and to discover similarities between the enzymes of different species of keratinophilic fungi and related dermatophytes (Mc Donald, 1985; Kunert and Kasafirek, 1988; Calvo *et al.*, 1991; Rajak *et al.*, 1991). The results generally confirmed that shared enzymes and shared catabolic routes both are responsible for the correlated abilities between taxa to use more than one substrate. Hence, an attempt is being made to have a better understanding of their taxonomy by observing morphological characters and keratin colonizing and degrading ability of some of the fungi isolated from Keoladeo National Park, Bharatpur (India).

MATERIALS AND METHODS

1. Studies on morphological characters:

Morphological characters were studied by growing these fungi on Sabouraud's Dextrose Agar (SDA) medium (Peptone-10 gm, dextrose-40 gm, agar-20 gm per liter of distilled water) at 28±2°C for 8 days of incubation period. During this growth period macromorphological characters *i.e.* colony texture, surface profile, colony colour, colour in reverse and other important characters were recorded.

2. Studies on colonization ability:

Human nails, buffalo tail hair, cow skin and chicken feathers were used with a view to understand colonization ability of the isolates following the methods of Vanbreusegham (1952) and Benedek (1962). The keratin substrates were cleanesed by washing several times in tap water, cut into small fragments, washed with chloroform and finally rinsed in sterile distilled water (Weary *et al.*, 1965). The substrates were sterilized by dry autoclaving (Geetha Singh and Agrawal, 1987). Sterilized baits were spread over the moistened 25 gm alluvial soil samples in 90 mm petriplates and incubated at 28 ± 2°C for 30 days. 10 ml of sterilized distilled water was added to provide moistened atmosphere for growing fungus periodically.

3. Studies on keratin degradation:

In order to assess keratin degradation by these fungi sterilized chicken feathers were used as keratin substrate using basal salt medium (glucose-10 gm, KNO_3 -5.4 gm, KH_2PO_4-1 gm, thiamine-100 mg, microelement solution -0.6 ml per litre of distilled water). The 1 ml of microelement solution contains : 1 mg Fe as Fe $(NH_4)_2(SO_4)_3$, 1 mg Zn as $ZnSO_4$, 0.5 mg Mn as $MnSO_4$, 0.8 mg Cu as $CuSO_4$, 0.1 mg Co as $CoSO_4$, 0.1 mg B as H_3BO_3.

An aliquot of 30 ml of the above basal medium was dispensed into 150 ml Erlenmeyer flasks and sterilized at 15 lbs pressure for 15 minutes. Two hundred and fifty mg of chicken feathers were added into each flask. The flasks were inoculated with an inoculum disc of 6 mm diameter (weight 5 mg) obtained from 8 days old colonies of the fungi and incubated at 28 ± 2°C for 30 days. Simultaneously controls were also run without adding the keratin substrate. After the said incubation period flasks were harvested through preweighed Whatman No. 1 filter paper discs. The filter papers with mycelial mats were folded and dried at 80°C for 24 hours. The per cent degradation was determined in comparison to the controls through 'weight loss method' (Fergus, 1969).

RESULTS AND DISCUSSION

The main identifying morphological characters of isolated fungi are as given below:

1. *Gymnoascus subumbrinus* Smith and Ramsbottom (CF6)

Colony ochre yellow, densely felty, floccose. Ascospores yellow to pale brown smooth, mostly oblate, size : 2-3x2-4 μm, reduced or mess like peridia and less markedly defined appendages. Dehiscence of spores schizolytic. Anamorphs have not been recorded.

TABLE -1

Keratin colonizing and degrading characters of isolated fungi

Name of Fungus	**Substrate (s) Colonized**	**% Degradation of chicken feathers**
Gymnoascus subumbrinus Smith & Ramsbottom (CF6)	Buffalo tail hair & Chicken feathers	0
Geotrichum candidum Link (CF 32)	Chicken feathers	41.8
Coccidioidis immitis Stiles (CF31)	Chicken feathers	33.4
Malbranchea chrysosporoidea Sigler & Carmichael (CF36)	Chicken feathers	35.2
Malbranchea flavorosea Sigler & Carmichael (CS59)	Cow skin	24.6
Malbranchea fulva Sigler & Carmichael (HN60)	Human nails	6.6
Malbranchea gypsea Sigler & Carmichael (HN33)	Human nails	41.6
Microsporum gypseum (Bodin) Guiart& Grigorakis (BTH2)	Buffalo tail hair	37.6
Trichophyton simii (Pinoy) Stockdale, Mackenzie & Austwick (HN34)	Human nails	77.8
Trichophyton terrestre Durie & Frey (CS7)	Cow skin	4.6

2. *Geotrichum candidum* Link (CF32)

Colony dry, hairy or powdery but when disturbed slimy. Arthroconidia hyaline, thin-walled and slimy, formed in chains by segmentation of undifferentiated hyphae, size : 1.5-2.5x2-4.5 μm, dehiscence : rhexolytic.

3. *Coccidioidis immitis* Stiles (CF31)

Colony texture slimy. Arthroconidia hyaline, closely spaced, sometimes separated by short segments, barrel-shaped, borne in intercalary or terminal position, size : 3-5x3-8 μm, dehiscence : rhexolytic.

4. *Malbranchea chrysosporoidea* Sigler and Carmichael (CF36)

Colony characteristically tan orange with downy central umbo, white exudate is being secreted out on culture ageing. Fertile hyphae bearing arthroconidia are of two types: i. straight, slightly broader, branched primary hyphae and ii. multiple, straight or curved, deflected lateral branches. The fertile branches bear intercalary conidia which intergrade with aleurioconidia formed terminally or laterally. Intercalary conidia are hyaline, cylindrical, 2-3x3-6 μm. Aleurioconidia are 2-3x3-5.5 μm in size, dehiscence : rhexolytic.

5. *Malbranchea flavorosea* Sigler and Carmichael (CS59)

Colony distinctly petalloid, creamy white, reverse dark tan in centre, yellow at the periphery, velvety. Arthroconidia developing on arcuate lateral branches and are cylindrical, hyaline, smooth, 1.5-2x3-5 μm, dehiscence : rhexolytic.

6. *Malbranchea fulva* Sigler and Carmichael (HN60)

Colony slowly growing, tan with yellow central umbo, zonate. Arthroconidia hyaline, cylindrical, smooth, 2.5-3.5x3.5-8 μm, borne on straight, branched hyphae. Racquet hyphae visible; at maturily arthroconidia develop refractile terminal walls; dehiscence : rhexolytic.

7. *Malbranchea gypsea* Sigler and Carmichael (HN33)

Colony smaller, chalky white or creamy, reverse buff, downy with prominent central umbo. Arthroconidia yellow, barrel-shaped, smooth, 2.5-3.5x5-8 μm, borne terminally or in an intercalary position on the straight primary hyphae or sometimes on short lateral branches, separated by one or more empty cells or occassionally formed immediately adjacent to each other, slightly broader than the interconnecting hyphae, dehiscence : rhexolytic.

8. *Microsporum gypseum* (Bodin) Guiart and Grigorakis (BTH2)

Colony floccose, spreading, ochre yellow, granular. Microconidia clavate, slightly roughened, 1-2x3-8 μm; Macroconidia moderately thick-walled, echinulate, verruculose, ellipsoid to fusiform, upto 5-septate, 7-15x30-45 μm, with a whip-like appendage, borne on reportedly branched conidiophore, dehiscence : rhexolytic.

9. *Trichophyton simii* (Pinoy) Stockdale, Mackenzie and Austwick (HN34)

Colony finely granular, pale yellow, later turning rose buff, with white, conical central umbo, rapidly growing. Microconidia abundant, clavate, borne sessile along the hyphae, 2-3x3-5 μm. Macroconidia numerous, terminal or on branched hyphae, occurring in clusters, cylindrical to spindle-shaped, smooth, thin-walled, 6-8x30-75 µm, 4 -10 septate. The formation of endochlamydospores at age is characteristic of species, dehiscence: rhexolytic.

10. *Trichophyton terrestre* Durie and Frey (CS7)

Colony floccose, patchy, off-white, reverse uncoloured. Microconidia clavate to cylindrical, 1.5-3x3-6.5 µm, borne on undifferentiated hyphae, sessile, intergrading with clavate to cylindrical, smooth-walled, 1-4 septate macroconidia (2-celled conidia formed in large number), 4-5x20-27 µm, dehiscence : rhexolytic.

A perusal of data (Table -1) revealed the effective colonization ability of fungi on keratin sources and degradation of keratin caused by them. In the present studies two classes of keratin substrates have been taken : (i) *Eukeratins*, represented by buffalo tail hair, human nails and chicken feathers which contained histidine, lysine and arginine in a definite proportion of 1:4:12 and 3-5% sulphur nearly all of which is cystine and (ii) *Pseudokeratins*, with different histidine, lysine and arginine ratio and less sulphur. This included cow skin (Hawk *et al.*, 1951). Studies on fungal colonization shows that arthroconidial forms *viz. M. gypsea, M. fulva, M. chrysosporoidea*, *C. immitis* and *G. candidum* (bearing arthroconidia on straight or arcuate fertile hyphae) colonized eukeratin substrates, human nails and chicken feathers only whereas, *M. flavorosea* was exception to this rule. Human nails were also colonized by *T. simii* and buffalo tail hair by *M. gypseum* (forms with macroconidia). Pseudokeratin substrate cow skin was colonized both by arthroconidial form *M. flavorosea* and macroconidial forms *T. terrestre*. *G. subumbrinus* with ascospores could colonize buffalo tail hair and chicken feathers. Colonization of keratin substrates by fungi may be either due to mechanical penetration or by the release of enzymes hydrolyzing keretin, thereby providing nutritional requirements for their growth (English, 1980; Jain and Agrawal, 1980; Kushwaha, 1983b; Deshmukh and Agrawal, 1985; Rajak *et al.*, 1991; Singh, 1993). However, data on colonization ability of keratin substrates do not draw any correlation between the morphological traits of fungi and type of substrate colonized.

Further studies on keratin degradation show that all the fungi except *G. subumbrinus*• were keratinolytic in nature. The ability of this fungus to grow on the chicken feathers was due to its saprophytic growth. It was reported that *T. simii* could cause a maximum degradation of 77.8% whereas, *T. terrestre* a minimum of 4.6%. This might be due to the fact that *T. simii* is a zoophilic dermatophyte in view of its most frequent and consistent association with birds and mammals (Gugnani and Randhawa, 1973). *T. terrestre* is relatively uncommon on birds (Rebell and Taplin, 1970) hence, probably unable to degrade the feathers frequently. The variable percentage of keratin degradation by other fungi was due to the differences in the amounts of the keratinolytic exoenzyme (s) produced by them and differences in substrate - specificity of enzyme(s) which the fungi synthesized (Kushwaha, 1983b; Geetha Singh and Agrawal, 1987; Singh *et al.*, 1995).

Fungi tested here have been classified, on the basis of their sexual reproductive stages and the keratin degradation capability within the family Arthrodermataceae (order Onygenales, class Ascomycetes) together with *G. subumbrinus* which belonged to family Gymnoascaceae of the same order (Currah, 1985). All fungi belonging to family Arthrodermataceae produced rhexolytically dehiscing conidia and displayed a similar specificity of enzymes against chicken feathers whereas, *G. subumbrinus* producing schizolytically dehiscing conidia differed in enzyme substrate-specificity, thus, obviously making distinction between the two families on morphological as well as biochemical basis.

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MYCOTAXON

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VERRUCARIA SOLICOLA, A NEW SOIL-INHABITING LICHEN FROM ALPINE AUSTRALIA

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ABSTRACT

The lichen *Verrucaria solicola* P. M. McCarthy sp. nov. (Ascomycota, Verrucariaceae) is described from soil in alpine New South Wales, Australia.

INTRODUCTION

All but a handful of the *c.* 300 species of the lichen genus *Verrucaria* Schrader are saxicolous in terrestrial, intertidal and aquatic habitats. Previous reports of terricolous taxa have come from the Northern Hemisphere, especially alpine Europe, Great Britain, Scandinavia and boreal Russia (Clauzade & Roux 1985, Orange 1991). In this paper, a new soil-inhabiting species is described from alpine New South Wales, south-eastern Australia.

METHODS

Hand sections and squash preparations were examined in water, 10% KOH and Lugol's iodine. Measurements of algae, thalline hyphae, periphyses and ascospores were made in water mounts at ×1000 magnification; those of ascomatal wall and asci were made at ×400 magnification. Ascospore dimensions are presented as mean values with extreme values in parentheses.

Verrucaria solicola P. M. McCarthy *sp. nov.* Fig. 1

Thallus terricolus, griseoviridis, continuus vel areolatus, 30–70(–120) µm crassus; areolae 0.1–0.25(–0.4) mm latae. Perithecia 1/3–3/4-immersa, nigra, (0.11–)0.18(–0.25) mm diametro, sine involucrello. Excipulum basaliter 15–25 µm crassum, prope apicem (35–)45(–60) µm crassum. Centrum 0.08–0.2 mm diametro. Periphyses 20–30 × 1.5–2.5 µm. Asci 48–60 × 14–18 µm. Ascosporae elongatae-ellipsoideae, (11–)15.5(–20) × (4.5–)6(–7.5) µm.

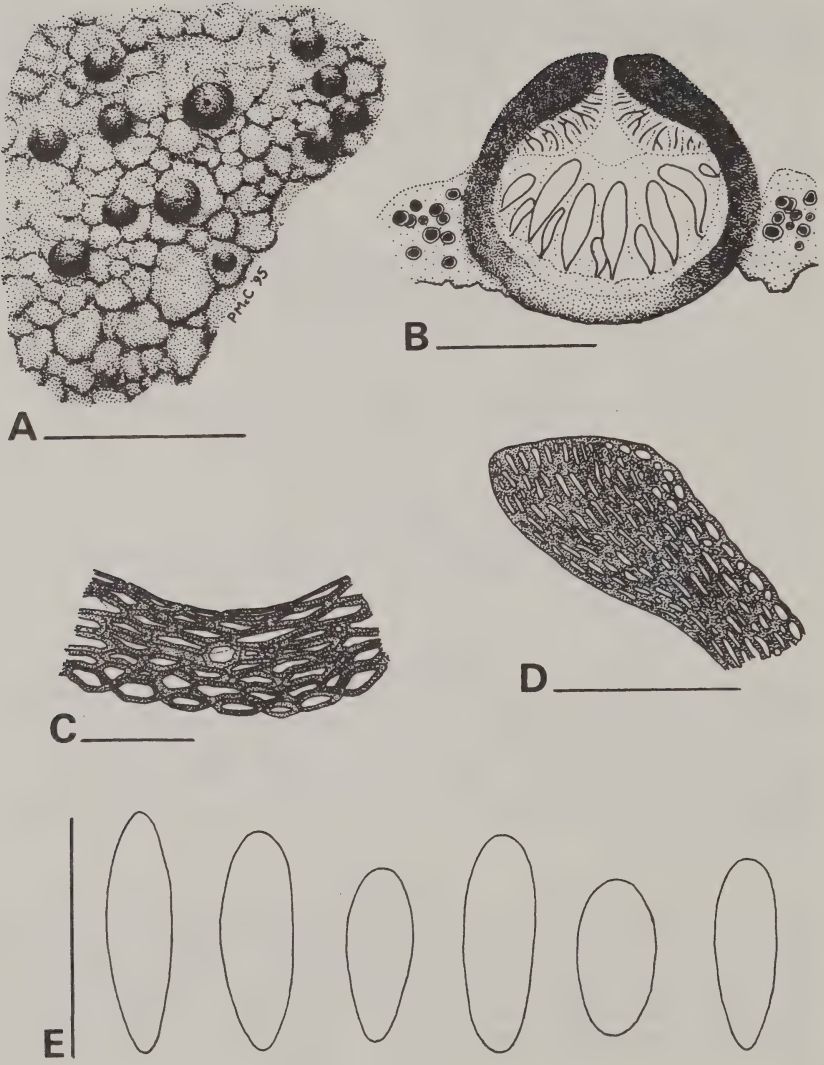

Fig. 1. *Verrucaria solicola* (holotype). A, Habit of thallus and perithecia; B, Vertical section of perithecium and adjacent thallus (semi-schematic); C, Vertical section of basal part of excipulum; D, Vertical section of apical part of excipulum; E, Ascospores. Scale A = 1 mm, B = 0.1 mm, C, E = 20 µm, D = 50 µm.

Type: Australia, New South Wales, Kosciusko National Park, Johnnies Plain, 36°26'S, 148°21'E, alt. 1750 m, on moist soil in solifluction hollow in alpine bog/grassland, 2.xii.1992, *G. Kantvilas 435/92 & J. A. Elix* (HO–holotype).

Thallus growing on soil, crustose, grey-green, determinate, rimose to areolate, matt, smooth to minutely uneven, 30–70(–120) µm thick, K–, ecorticate but sometimes with an uppermost, 10–20 µm thick, alga-free layer; goniocysts lacking. *Areolae* scattered or contiguous, rounded to irregular, plane to convex, occasionally lobate, 0.1–0.25(–0.4) mm wide. *Photobiont cells* globose, (4–)6–10(–15) µm diam. *Mycobiont cells* rounded to angular, 3–5 µm wide. *Prothallus* not apparent. *Perithecia* very numerous, 1/3–3/4-immersed, black, (0.11–)0.18(–0.25) mm diam., lacking an involucrellum. *Perithecial apex* usually rounded, occasionally slightly flattened. *Ostiole* inconspicuous or in a shallow, 20 µm wide depression. *Excipulum* grey-brown to dark olive-brown and 15–25 µm thick at the base and sides (often palest at the base), uniformly dark olive-brown and (35–)45(–60) µm thick towards the apex, K–. *Centrum* globose to depressed-ovate, 0.08–0.2 mm diam., Lugol's I+ red-brown. *Paraphyses* absent. *Periphyses* sparingly branched, 20–30 × 1.5–2.5 µm. *Asci* fissitunicate, 8-spored, clavate to cylindroclavate, 48–60 × 14–18 µm. *Ascospores* simple, colourless, elongate-ellipsoid, often slightly broader towards the distal end, (11–)15.5(–20) × (4.5–)6(–7.5) µm (60 measured); contents finely granular, frequently monoguttulate. *Conidiomata* not seen.

Notes: The Australian lichen is readily distinguishable from the few terricolous species of *Verrucaria* already known. Thus, the perithecia are discontinuously smaller than those of *V. geophila* Zahlbr. and *V. sibirica* Zahlbr. and the ascospores are larger than the subglobose propagules of *V. bernaicensis* Malbr. and *V. terrigena* Zschacke but are smaller than those of *V. bryoctona* (Th. Fr.) Orange (Clauzade & Roux 1985, Orange 1991). Conversely, the morphology and dimensions of the perithecia and their contents are very similar to those of the cool-temperate to boreal European *V. xyloxena* Norman. However, the latter has a granular-verrucose thallus composed of brown-pigmented goniocysts, i.e. clusters of algae enclosed by ±isodiametric fungal cells (Orange 1991).

Verrucaria solicola is known only from its type locality in alpine New South Wales, south-eastern Australia. The specific epithet is derived from the Latin *solum* (soil) and the suffix *-icola* (dweller).

ACKNOWLEDGEMENT

I am grateful to Dr Gintaras Kantvilas (Tasmanian Herbarium, Hobart) for making the type specimen of *V. solicola* available to me.

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ARCYRIA RUFOSA: A NEW INDIAN MYXOMYCETE

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Abstract: A new species of myxomycete, *Arcyria rufosa* is described from India.

Introduction: During our studies on myxomycetes, fifteen species of *Arcyria* were collected from different parts of the country and described earlier (Lakhanpal and Mukerji 1979, 1981). The present collection was found to be a new species and is described here as *Arcyria rufosa*. This was collected in October 1982 from Pachmari and had also been obtained in moist chamber cultures (Nannenga Bremekamp *et al*, 1984).

Arcyria rufosa sp. nov. (Fig. 1)

Sporangiis dense gregariis, stipite, 6.5-7.8 mm altis expansio post dehiscentibus, rufus, globosis vel ovalis, 3.2-4.1 mm diam. Peridio fugaceous, calyculus distincto, lato infundibuliformis cum lato anthrocino levis basi cum laxe affixo capillitia separatae facile a calyculus anastomosi, armeniacus absque liber extremis, 3-6 µm lato, elasto vel semicircularis, protuberulentes vel spinulose, conflata anastomosi minutus crista, inflato ad loco. Sporis globosis in massa, rufosus, 3-9 µm lato, levis, raro inconspicuo verrucato. Stipite 1.2-1.9 mm altis cylindricis, hypothalo confluento, plasmodium incognito.

Fructifications sporangiate, stipitate, upto 6.5-7.8 mm in length, expanding after dehiscence, sporangia densely crowded, reddish brown in colour. Each sporangium is spherical to oval, 3.2-4.1 mm in diameter, deep red brown. Peridium fugaceous above, leaving a well defined calyculus, broadly funnel shaped with broad black base, smooth and shining with loosely attached capillitia, separating easily from calyculus, network composed of branched and anastomosed orange, red threads without free ends, 3-6 µm wide, highly elastic with half rings, cogs, pegs and spines joined by a network of minute ridges, swollen at places, spore mass reddish brown, globose, almost smooth, sometimes with a few conspicuous scattered

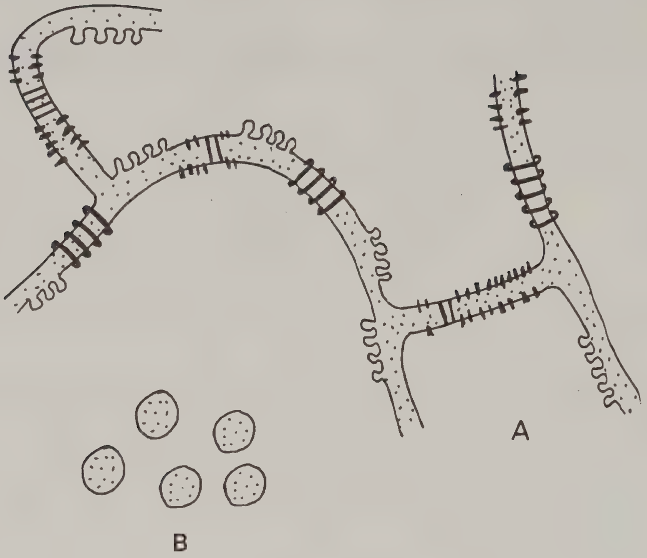

Fig. 1: *Arcyria rufosa* sp. nov. Capillitial threads, with cogs and half rings, x 450. B. Spores x 600.

warts, 3-9 µm in diameter, stipe 1.2-1.9 mm in length, cylindrical, filled with spore like cells, hypothallus small, dark brown, confluent. Plasmodium not observed.

Holotype: DU/MUK 539, leg. K.G. Mukerji on barks of *Shorea robusta* and *Diospyros melanxylon* from natural forest stand located at Chota Mahadev on the Pachmari Plateau alt ca 1067 m Oct. 1982. An isotype is in collection of Dr. N.E. Nannenga-Bremekamp, Utsechtseweg 422, 6865 Doorworth, the Netherlands under reference number 13.730. Dr. Nannenga-Bremekamp has informed us that, she has also seen two other specimens of this fungus, one collected from France (12.440) and the other from Austria (14.193).

This species is very close to *Arcyria ferruginea* Sauter. However, this is reddish brown in colour and *A. rufosa* is rust coloured. The sporangia in the present species are more than five times longer than *A. ferruginea.* Spores in the present species are smooth with rarely few scattered warts, whereas in *A. ferruginea,* the spores are with regular large warts. It differs in its spore, capillitia and stalk from rest of the species.

The species has been named as *Arcyria rufosa* based on the characteristic colour of the sporangia.

Acknowledgments: The authors are thankful to Dr. Nannenga-Bremekamp, the Netherlands for confirming the identification of this species and to Professor T.N. Lakhanpal, India for critical review of the manuscript. The senior author is grateful to University Grants Commission for providing financial assistance.

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TWO NEW FOLIICOLOUS SPECIES OF CALENIA (LICHENS, GOMPHILLACEAE) FROM COSTA RICA

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Summary

Two new species of *Calenia* are described and their relationship to other species of *Calenia*, *Gyalectidium* and *Caleniopsis* is discussed. *Calenia lückingii* is characterized by a verrucose and dispersed thallus structure, large apotheciae with hymenial algae and muriformly septated ascospores and by tapering white hyphophores with algal cells between the diahyphae. *Calenia rolandiana* is characterized by pale yellowish apotheciae with a well distinguishable inner and outer margin, muriformly septated ascospores and tapering black hyphophores.

Introduction

The lichen family Gomphillaceae W. WATS. ex HAF., which was suggested by Watson (1929) and established by Hafellner (1984) as a monotypic family for the genus *Gomphillus* NYL., was later enlarged by Vezda and Poelt (1987), who accomodated seven related genera of the Asterothyriaceae W. WATS ex SANT. to the Gomphillaceae. These were the genera *Calenia* MÜLL. ARG. em SANT., *Aulaxina* FEÉ, *Echinoplaca* FEÉ, *Gyalectidium* MÜLL. ARG., *Tricharia* FEÉ em SANT., *Actinoplaca* MÜLL. ARG. and *Gyalideopsis* VEZDA. Additionally two new genera were described: *Bullatina* VEZDA et POELT and *Caleniopsis* VEZDA et POELT.

The family Gomphillaceae now forms a clearly delimitated entity characterized by biatorine apothecia, thin branched and anastomosing paraphyses, fissitunicate, J-negative asci, hyalinous, transversely or muriformly septated ascospores, and specific asexual reproduction organs called hyphophores (Vezda 1979, Vezda and Poelt 1987). The separation between the single genera, however, has become somewhat difficult in the last few years, since several new species have been described and the genera should be newly defined to allow clear differentiation, particularly in *Echinoplaca*, *Tricharia*, *Gyalectidium* and *Calenia*.

In the following two new species of *Calenia* are described, found on leaves at several localities in Costa Rica, Central America.

Calenia lückingii C. HARTMANN sp. n.

Thallus epiphyllus, tenuis, dispersus, notabilibus verrucis, nitidus, cristallis instructus, ecorticatus, virido-albescens.
Hyphophori setiformes, albi, partes apicales fusco-nigri. Conidia hyalina, ex latere hyphophori profluentia, saepe cellulas algarum includentia.
Apothecia lata basi in thallo insidentia, diam. 0.4-0.6 mm, simplicia aut raro 2 confluentia. Margo thallo concolorius, elevatus, irregularis rotundatus, verrucosus. Excipulum proprium indistinctum. Discus fusco-luteus vel olivaceus, planus vel leviter concavus. Epithecium fusco-luteum, cellulis algarum instructum. Hymenium J-, incoloratum. Hypothecium paraplectenchymaticum, incoloratum. Paraphyses ramosae anastomosantesque, crass. 0.001 mm. Asci late clavati, 0.04-0.07 x 0.02-0.03 mm. Sporae 1: nae, muriformes, ellipticae vel ovatae, 0.04-0.05 x 0.02-0.03 mm. Alga ad Chlorococcaceas pertinens, 0.007-0.01 mm diam.

Holotype: Costa Rica, Heredia province, Sarapiqui region, parc rangers station El Ceibo at the margin of Braulio Carillo National Parc, 9 km SE of the village La Virgen, next to Rio Peje; 84°05´W / 10°20´N; c. 600 m; tropical premontane wet transition rain forest zone; on leaves of *Ardisia sp.* (Myrsinaceae) on open pasture a few meters outside the forest. Leg. C. Hartmann July 1990, n. 90-61, herb. University of Ulm (ULM).- Isotypes: Herb. C. Hartmann, n. 90-62 to 90-65.

Thallus epiphyllous, crustose, 0.02-0.03 mm thick, dispersed into single patches of 0.2-1.0 mm diameter connected by a colourless prothallus. Thallus strongly encrusted with uncoloured cristals, provided with irregular warts up to 0.08 mm diameter, slightly green to whitish, nitidous.
Tapering white hyphophores usually present, up to 0.15 mm long and 0.02 mm thick, tip brownish black. Diahyphae coming out of the hyphophore in unbranched chains a little below the tip, forming colourless drops including some small, globose algal cells. Conidial cells at the end of the chains 0.005 x 0.001 mm.
Apothecia 0.4-0.6 mm in diameter, broadly sessile, at first immersed, then protruding, final height about 0.08 mm. Generally one single apothecium on each thallus patch, rarely two apothecia confluent. Margin of the apothecium formed by thallus tissue, excipulum reduced. Margin prominent, irregularly rounded, verrucose. Apothecial disc brownish yellow to olive green, plane to slightly concave. Hymenium J-, uncoloured, K+ reddish brown, up to 0.05 mm thick. Epithecium 0.01-0.02 mm thick, brownish yellow, provided with algal cells. Hypothecium paraplectenchymatous, 0.02-0.03 mm thick, uncoloured. Numerous paraphyses present, abundantly branched and anastomosing, 0.001 mm strong. Asci clavate, 0.04-0.07 x 0.02-0.03 mm large. Spores single in the ascus, showing muriform septation, ellipsoid to ovate, up to 0.04-0.05 x 0.02-0.03 mm large. Symbiontic alga of the family Chlorococcaceae, with green globose cells of 0.007-0.01 mm diameter.

Photographs: Fig. 1(a) habitus, (b) hyphophore, (c) section through apothecium.

Additional specimens examined: - Costa Rica, type locality; on leaves of various dicotyledones, n. 90-62 to 90-65 (herb. C. Hartmann). - Costa Rica, Guayabo National Monument, Carthago province, c. 19 km north of the village Turrialba, on the southern slope of vulcano Turrialba, 83°42´W / 9°57´N; c. 1000m; tropical premontane rain forst zone, on leaves of *Heliconia sp.* (Musaceae) in open secondary forest. Leg. R. Lücking n. 1807 (herb. R. Lücking). - The species has also been reported from Las Cruces, Puntarenas province, Costa Rica (Lücking 1992a).

Calenia lückingii is dedicated to Dr. Robert Lücking, who is working since several years on the foliicolous lichens of Costa Rica.

The new species is characterized by large apothecia with irregularly rounded margins and olivaceus discs, muriformly septated ascospores and a dispersed and verrucose thallus structure. The presence of hymenial algae, the reduced excipulum and the structure of the thallus show some relationships to *Gyalectidium*. The latter genus, however, is restricted to species with specific, squamiform hyphophores (Vezda 1984, Vezda & Poelt 1987). As the new species shows tapering hyphophores and broadly sessile, but protruding apothecia with an outer margin of thallus tissue, it fits quite well the characteristics of the genus *Calenia* as given by Santesson (1952). It markedly differs, however, to other species with muriformly septated ascospores like C. *monospora* Vezda (1979), *C. microcarpa* Vezda (1979), *C. africana* Serusiaux (1978) and *C. solorinoides* Lücking (1991a) by the greater size of apothecia and spores, different colour of the apothecial disc and by different thallus characteristics. Moreover *C. lückingii* presents algal cells in the hymenium and between the conidial chains, a characteristic which is known in the Gomphillaceae, but which has not yet been reported for the genus *Calenia*.

Calenia rolandiana C. HARTMANN sp. n.

Thallus epiphyllus, tenuis, dispersus vel continuus, tenuibus verrucis, nitidus, cristallis instructus, ecorticatus, virido-albescens.
Hyphophori setiformes, nigri. Conidia moniliformia, hyalina, ex acumine hyphophori profluentia.
Apothecia lata basi in thallo insidentia, diam. 0.25-0.4 mm, simplicia. Margo exterior thallo concolorius, elevatus, aequaliter rotundatus. Excipulum proprium saepe margo secundus formans, disco concolorius, cellulas algarum carens. Discus subflavus, planus vel leviter concavus. Epithecium indistinctum. Hypothecium paraplectenchymaticum, non coloratum. Hymenium J-, incoloratum. Paraphyses ramosae anastomosantesque, crass. 0.001 mm. Asci late clavati, 0.05-0.07 x 0.02-0.03 mm. Sporae 1: nae, muriformes, ellipticae vel ovatae, 0.04-0.06 x 0.02-0.03 mm. Alga ad Chlorococcaceas pertinens, 0.004-0.01 mm diam.

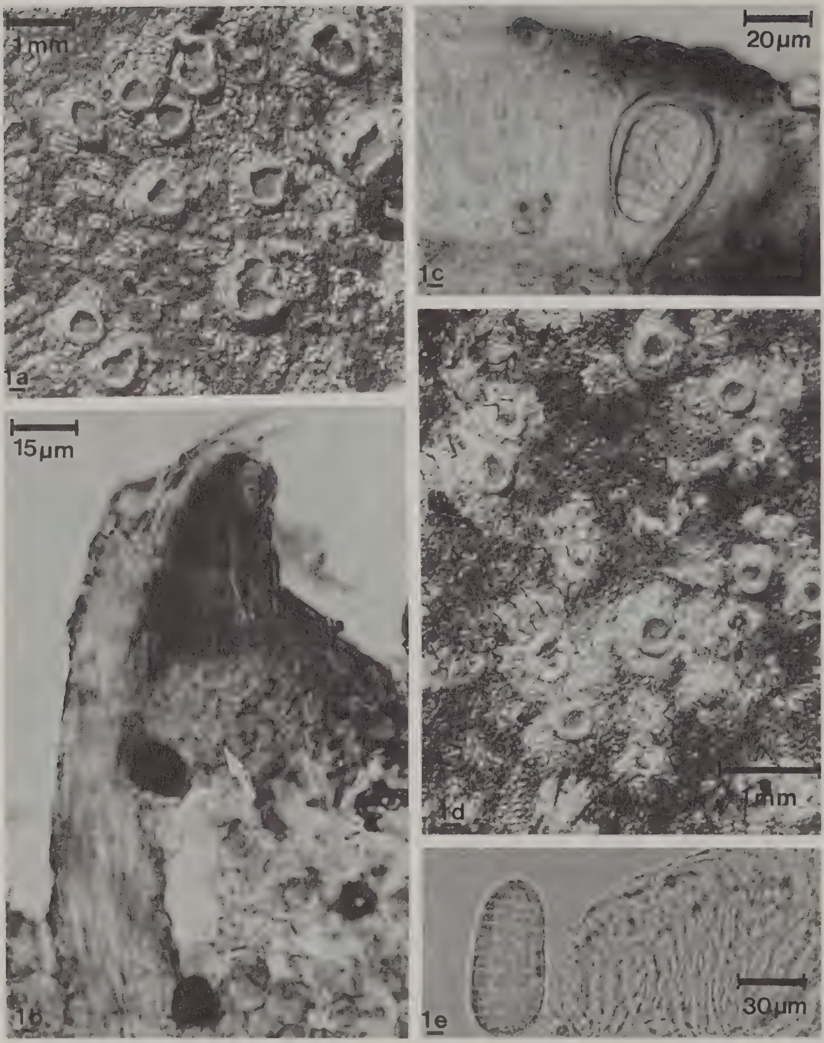

Fig. 1. (a-c) *Calenia lückingii* sp. n.; (a) habitus - irregularly rounded apothecia, dispersed and verrucose thallus ; (b) hyphophore with attached drop of diahyphae including globose algal cells (white arrow); (c) section through apothecium - branched paraphyses and young ascus containing muriformly septated ascospore; (d-e) *Calenia rolandiana* sp. n.; (d) habitus - apothecia and black hyphophores; (e) muriformly septated ascospore and branched paraphyses.

Holotype: Costa Rica, Heredia province, Sarapiqui region, parc rangers station El Ceibo at the margin of Braulio Carillo National Parc, 9 km SE of the village La Virgen, next to Rio Peje; 84°05´W / 10°20´N; c. 600 m; tropical premontane wet transition rain forest zone; on leaves of *Guatteria sp.* (Annonaceae), primary forest, 220 m inside. Leg. C. Hartmann July 1990, n. 90-71, herb. University of Ulm (ULM).- Isotypes: Herb. C. Hartmann, n. 90-72 to 90-74.

Thallus epiphyllous, thin and crustose, dispersed or single thalli confluent, slightly green to whitish, prothallus uncoloured. Thallus surface somewhat uneven whith small warts up to 0.04 mm in diameter caused by colourless cristals.
Tapering black hyphophores regularly present, situated mainly in the marginal regions of the thallus. Longer, sterile black hairs with squamiformly widened tips sometimes growing single between the hyphophores. Hyphophores up to 0.16 mm long and 0.01 mm thick, in the upper part bended, tips pointed or slightly widened. Diahyphae coming out of the hyphophoral tips in unbranched chains forming small colourless drops. Single conidial cells 0.009 x 0.001 mm large. Apothecia broadly seated and regularly rounded, 0.25-0.4 mm in diameter and up to 0.07 mm in height. Apothecial margin prominent, consisting of an exterior layer of thallus tissue and an interior layer of algal-free excipulum sometimes protruding in triangular lobes. Apothecial disc pale yellowish, slightly concave. Hypothecium paraplectenchymatous, 0.03 mm thick, uncoloured. Epithecium hardly distinguishable, uncoloured, without algal cells. Hymenium 0.04-0.05 mm thick, J- uncoloured, K+ reddish brown. Numerous paraphyses present, abundantly branched and anastomosing, 0.001 mm strong. Asci clavate, 0.05-0.07 x 0.02-0.03 mm large. Spores single in the ascus, muriformly septated, ellipsoid to ovate, 0.04-0.06 x 0.02-0.03 mm large. Symbiotic alga of the family Chlorococcaceae, with green globose cells 0.004-0.01 mm in diameter.

Photographs: Fig. 1(d) habitus, 1 (e) ascospore.

Additional specimens examined: - Costa Rica, San José province, Braulio Carillo National Parc, Quebrada Gonzáles section, Botarrama natural path, atlantic slope of Cordillera Central, next to Rio Honduras and highway San José-Limon; 83°56´W / 10°09´N; 470 m; tropical premontane wet transition rainforest zone, on leaves of *Carludovica sp.* (Cyclanthaceae), n. 981/2 (herb. R. Lücking).
Calenia rolandiana is dedicated to my husband Dr. Roland Rahm.

The new species is characterized by black hyphophores and large, muriformly septated spores appearing single in the ascus. The thallus surface is slightly verrucose. The apothecial structure with a well defined, algal-free inner margin and an outer layer of thallus tissue is typical for the genus *Calenia* as described by Poelt and Vezda (1987).

Calenia is known to have tapering white or brownish hyphophores. The tapering black hyphophores of the new species might show some relationship to *Caleniopsis*, a rare genus up to now only known by one species from the Amazonal region (Kalb and Vezda 1988b). *Calenia rolandiana*, however, is missing the black prothallus typical for *Caleniopsis* and its hyphophores are slightly bended in the upper part, whereas in *Caleniopsis* they are stiff and rather short like in *Aulaxina*.

Acknowledgements

I am grateful to the German Academic Exchange Service (DAAD) for the financial support of a one-year exchange programme to Costa Rica. During my research in this time on the ecology of the foliicolous lichens the new species were collected. The Costa Rican National Parc Service kindly gave the permission for gathering at several localities, and the parc rangers of El Ceibo, especially Mr. Reinaldo Aquilar Fernandez, helped me a lot to get to the collecting sites. In particular I wish to thank Dr. A. Vezda and Dr. R. Lücking for checking the Latin and German diagnosis of the new species and for critical remarks on the manuscript.

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Editor's note: The name *Calenia lückengii* as proposed and used in this paper is incorrect, since the International Code of Botanical Nomenclature (Art. 60.6) requires that the name be rendered as *Calenia lueckengii*. This erratum corrects that error.

MYCOTAXON

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STEROID BIOTRANSFORMING STRAINS DESIGNATED *COCHLIOBOLUS LUNATUS* m118 AND *CURVULARIA LUNATA* AT46 ARE BOTH *CURVULARIA LUNATA VAR. LUNATA*

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Abstract

The two strains designated "*Cochliobolus lunatus* m118" (MUCL 38696) and "*Curvularia lunata* AT46" (MUCL 38697) are both important for production of corticosteroids. The strain *Cochliobolus lunatus* m118 developed mycelium only; no conidia nor ascomata were observed *Curvularia lunata* AT46 produced some conidia on current growth media and conditions. We present for the first time the successful conidiation of "m118" on the special growth media and light. Although the strains did not cross nor did with other MUCL *Curvularia lunata* strains, remaining both asexual, they produced identical conidiation on specific media and under near UV light. Both strains gave the same results with API ZYM 20 (Biomerieux) test and they hybridized well with a randomly cloned *Cochliobolus lunatus* genomic probe. RAPD profiles with different primers showed some identical (species specific) markers and several nonidentical (strain specific) markers. Results demonstate that strains m118 and AT46 which have been widely used in biochemical and molecular biology studies but did not have a documented taxonomical classification, are two non-compatible *Curvularia lunata var. lunata* strains.

Introduction

Steroid biotransformation reactions catalyzed by microorganisms are still important for production of corticosteroids. *Cochliobolus lunatus* m118 and *Curvularia lunata* AT46 are two strains of ascomycetes that mediate 11β-hydroxylation of the steroid ring. A number of steroid biotransformations have been reported by these two, as well as other *C. lunata* strains (1), followed by protein characterizations and purifications (2,3) and molecular biology studies (4,5,6). Although *Curvularia lunata* is the conidial anamorph of *Cochliobolus lunatus* (7,8), the relationship between the nonsporulating *Cochliobolus lunatus* m118 and conidia forming *Curvularia lunata* AT46 was unclear and some of the work was done in parallel with both fungi. According to our knowledge, the documentation about the origin of both strains is not available, in the case of *C. lunatus* m118 because the strain has been under the patent law 90DD-339295 900402.

We recently reported similarities in the electrophoretic karyotype of both strains, the closely related RAPD pattern with one of the primers form microsatellite sequences, by which we distinguished both strains from the controls, but we found significant differences in ultrastructure of the two strains (9). We concluded that although the strains are closely related, their relationship is still undefined.

Here we present phenotypic and genotypic evidence which demonstrate that *Cochliobolus lunatus* m118 and *Curvularia lunata* AT46 are two non-compatible anamorph strains of *Cochliobolus lunatus*, properly deserving the anamorphic name *Curvularia lunata.*

Materials and Methods

Fungal strains and growth conditions

Cochliobolus lunatus m118 was obtained from the fungus collection of Friedrich Schiller University, Jena, FRG. *Curvularia lunata* AT 46 was kindly provided by Dr. H. Osiewacz, Heidelberg, FRG. Both strains were without available documentation and we were unable to find any references regarding their origin or identification. Strains were deposited recently by the Mycotheque de l'Université Catholique de Louvain (MUCL), Belgium as MUCL 38696 and MUCL 38697, respectively. The control strains *Fusarium graminarium* and *F. heterosporum* were a gift of Dr. Kelvin Smith, Queen Mary and Westfield College, London.

All strains were grown in malt extract medium as described previously (10). For conidiation experiments strains were grown under near UV light on cellulose agar (10 g milled cellulose, 0.5 g L-asparagine, 0.5 g yeast extract, 0.5 g $(NH_4)_2SO_4$, 1 g K_2HPO_4, 0.5 KCl, 0.2 $MgSO_4.7H_2O$, 1 g $CaCl_2$, 20 g agar/l, pH 6.2) and on V8 agar (200 ml vegetable juice V8 (Campell Soup Company Ltd, Canada), 3 g $CaC0_3$, 15 g agar/l, pH 7.2. Crossings of strains for production of ascomata were carried out on sterile barley grains embedded in Sach's agar (1 g $Ca(NO_3)_2.4H_2O$, 0.25 g $K_2HPO_4.3H_2O$, 0.25 g KCl, 0.25 g $MgSO_4.7H_2O$, 0.85 g $CaCO_3$, trace of $FeCl_3$, 20 g agar/l) (5).

The API ZYM (Biomerieux) test

The API ZYM gallery is composed of 20 microtubes, 19 of which contains one enzyme specific substrate and buffer, the last one being a blank. Liquid shake cultures in malt extract broth were centrifuged and suspended in 2 ml sterile distilled water to a McFarland turbidity of 5 - 6. Two drops of the fungal suspension were inoculated into each microtube, the gallery was covered and incubated for 4 hours at 37°C in darkness. After incubation one drop of tri-hydroxymethyl-amino-methane reagent ZYM A and one drop of fast-blue BB reagent ZYM B were added to each microtube. Exposure took place for 5 min in bright day light or tungsten light. Colour reactions were recorded in comparison to the ZYM colour chart and scaled from 0 to 5.

Isolation of internal hybridization probe

5 µg of genomic DNA of *Cochliobolus lunatus* m118 was cleaved with restriction enzyme *Bam* HI. Restriction pattern was resolved on 1 % low melting temperature agarose (Sigma), fragments from 1.0 - 1.5 kb were excised and purified from the gel using "Magic PCR Preps DNA Purification System" (Promega) and further cloned in *Bam HI* linearized dephosphorylated vector pUC 19. Recombinant plasmids were transformed in *E. coli* DH5α cells. Cells harboring recombinant plasmids were selected on ampicilin and chromophoric agent X-gal. Minipreparation of recombinant plasmids was achieved by the protocol using alkaline lysis of bacterial cells. The cloned fragments were excised from recombinant plasmids by cleavage with restriction enzyme *Bam* HI and purified from 1 % low melting temperature agarose as described before. Experimental details are described in standard literature (11).

Isolation of chromosomal DNA and hybridization analysis

Samples of fungal genomic DNAs were isolated from 1.5 g of frozen mycelium following the protocol described previously (12). Digestion with restriction endonuclease *Bam* HI, electrophoresis and blotting, were performed under standard conditions (11). The 1.3 kb fragment, randomly cloned from *C. lunatus* genomic DNA, labelled with ^{32}Pα-dCTP using the Multiprime DNA labelling system (Amersham), was taken as a probe. Prehybridization and hybridization were performed on a rotatory shaker at 42°C in solutions containing 50 % formamide (11). 1 X 10^7 cpm/ml of labelled probe was added in the hybridization mixture.

Amplification of genomic DNA using primers of arbitrary sequences

Amplification reactions were performed in 50 µl. Reaction mixtures consisted of 200 ng of genomic DNA, 200 pmol of primer, 0.2 mM (each) of dNTPs, 1X *Taq* DNA polymerase buffer (Promega), 2.0 mM $MgCl_2$ and 2.5 U of *Taq* polymerase. The reaction conditions for arbitrary 10-base primers (50_2:GCAAGTAGCT; 50_3:TGGTCAGTCA; 60_2:CGGTCACTGT; 70_1: TCACA-GGCCG; 80_1 :CGCGTGCCCA) were : 94°C 5 min, 45 cycles of: 94°C 30 s, 38°C 60 s and 72°C 60 s, 72°C 7 min. PCR cycling conditions using 16-base microsatellite primers $(GACA)_4$ and $(TGTC)_4$ were: 93°C 3 min, 45 cycles of 93°C 20s, 38°C 60 s and 72°C 20 s and a final extension phase of 72°C for 7 min. For 24-base microsatellite primer $(GATA)_6$ and for combination of two microsatellite primers a 35-cycle reaction with 1.5 mM $MgCl_2$ was performed. The conditions were as follows: 700 pmol of primer $(GATA)_6$: 93°C 2 min, 35 cycles of 93°C 20s, 42°C C 60 s, 72°C 20 s; 72°C 7 min; 400 pmol of primer $(GTG)_5$, 350 pmol of primer $(GATA)_6$: 93°C 2 min, 35 cycles of 93°C 20s, 45°C C 60 s, 72°C 20 s; 72°C 7 min.

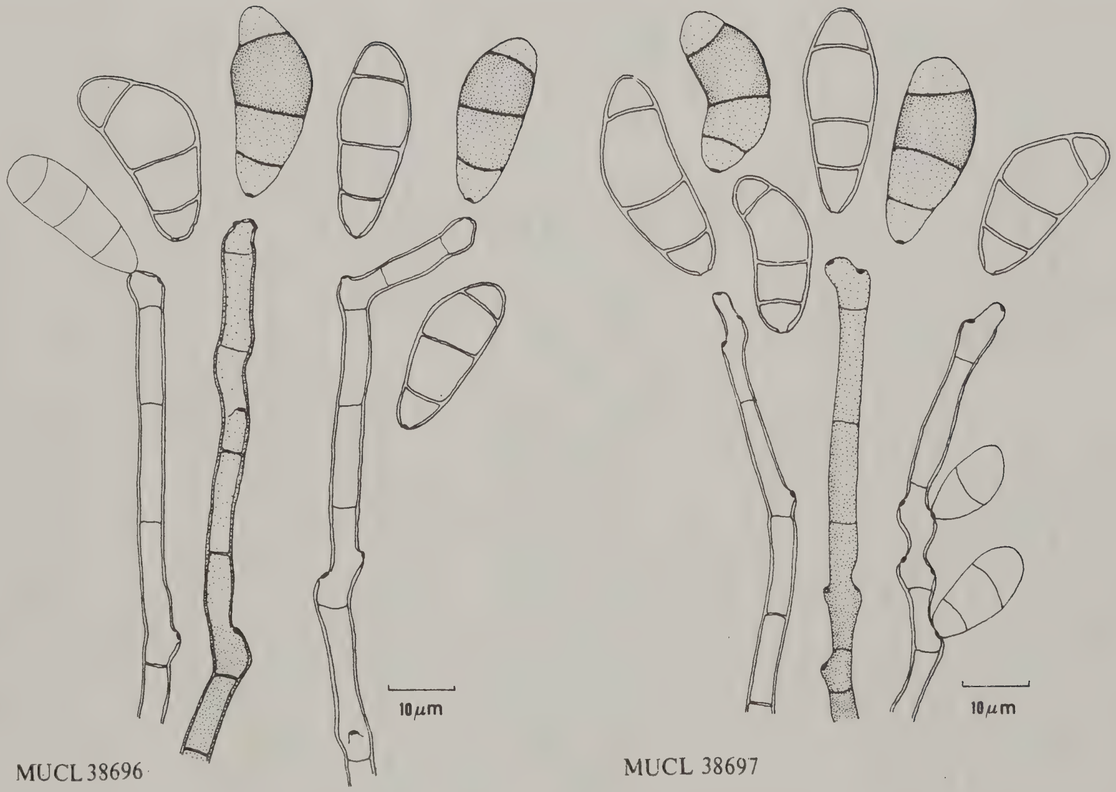
10μm
10μm
MUCL 38696
MUCL 38697

Fig. 1. Conidiophores and conidia of strains m118 and AT46 obtained on V8 agar and under near UV light

Results

Conidial sporulation

Conidiophores and conidia were readily produced by both strains m118 and AT46 under our culture conditions (Fig 1A, B). Conidiophores were erect, usually unbranched, septate, geniculate by intervals, brown and smooth. Conidiogenous cells were integrated, at first terminal, becoming intercalary, sympodial, bearing geniculate conidial scars of. Conidia were solitary, successive, smooth, brown, 3-distoseptate, almost always assymetrically swollen and curved at the third cell from the base, which is larger and darker while basal and distal cells are pale, 20.5-31 x 10.5-12.5 µm, with non protrudent but conspicuous attachment scar at the base. No stromata were produced. The morphology of the conidial state matches the published descriptions (12, 13) of *Curvularia lunata* var. *lunata*

Hybridization with the randomly cloned genomic probe

A 1.3 kb fragment was randomly cloned from genomic DNA of *Cochliobolus lunatus* m118 and used as hybridization probe. The cleaved DNA samples of *C. lunatus* m118 and *C. lunata* AT46 produced a strong hybridization signal with the probe while in control *Fusarium* strains, as well as in λ phage DNA, the signal was absent (Fig 2A,B).

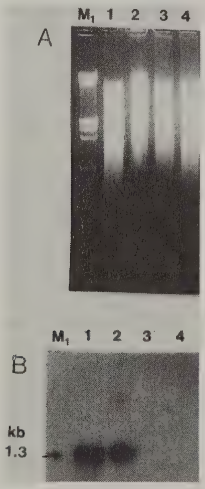

Fig. 2. Electrophoretic picture of *Bam HI* cleaved fungal DNA samples (A) and the respective hybridization picture (B). The randomly cloned segment of *C. lunatus* m118 was taken as a probe. 1 - *C. lunatus* MUCL 38606; 2 - *C. lunata* AT46; 3 - *Fusarium heterosporum*; 4 - *F. graminarium*; M_1 - λDNA *Eco RI/ Hind III.*

Evaluation of enzymatic activities with the API ZYM test

This semiquantitative micromethod allows a rapid study of 19 enzymatic reactions. The results are presented on Table 1. It could clearly be seen that *Cochliobolus lunatus* m118 and *Curvularia lunata* AT46 metabolize the same substrates with the same efficiency.

Substrate	38696	38697
control	0	0
2-naphtyl-phosphate	4	5
2-naphtyl-butyrate	2	2
2-naphtyl-caprylate	2	2
2-naphtyl-myristate	0	0
L-leucyl-2-naphtylamide	1	1
L-valyl-2-naphtylamide	0-1	0-1
L-cystyl-2-naphtylamide	0	0
N-benzoyl-DL-arginine-2-naphtylamide	0	0
N-glutaryl-phenylalanine-2-naphtylamide	0	0
2-naphtyl-phosphate	3	3
Naphtol-AS-BI-phosphodiamide	1	1
6-Br-2-naphtyl-αD- galactopyranoside	3	3
2-naphtyl-βD- galactopyranoside	3	3
Naphtol-AS-BI-βD-glucuronat	0	0
2-naphtyl-αD - glucopyranoside	1	1
6-Br-2-naphtyl-βD - glucopyranoside	5	5
1/naphtyl-N-acetyl-βD-glucosaminide	5	5
6-Br-2-naphtyl-αD-mannopyranoside	1	1
2-naphtyl-αL-fucopyranoside	0	0

Table 1. The API ZYM test - quantity of hydrolised substrates by the strains *C. lunatus* m118 and *C. lunata* AT46. **0** - 0 nmol; **1** - 5 nmol; **2** - 10 nmol; **3** - 20 nmol; **4** - 30 nmol; **5** - ≥ 40 nmol.

RAPD profiles of C. lunatus MUCL 38606 and C. lunata MUCL 38697

Using several primers for amplification it is possible to randomly screen various parts of each genome. We used arbitrary 10-mer primers (Fig. 3 A-D) as well as primers form microsatellite sequences (Fig. 3 E-I). The number of identical (species specific) RAPD markers produced by the two strains varied form primer to primer; it means that genomes of *C. lunatus* m118 and *C. lunata* AT46 have some parts with identical nucleotide sequences and parts where nucleotide sequences are not conserved.

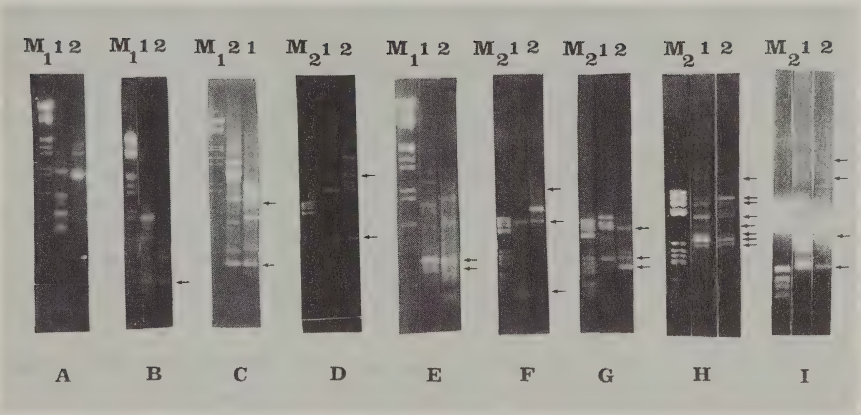
M1 1 2
M1 1 2
M1 2 1
M2 1 2
M1 1 2
M2 1 2
M2 1 2
M2 1 2
M2 1 2
A
B
C
D
E
F
G
H
I

Fig. 3. RAPD profiles of *C. lunatus* m118 (1) and *C. lunata* AT46 (2) with different primers. Species specific RAPD markers are pointed with arrows.1 - *C. lunatus* m118; 2 - *C. lunata* AT46; M_1 - λDNA *EcoRI/Hind III*; M_2 - pBR322*/Hae III.* A: 50_2 ; B: 50_3; C: 60_2; D: 70_1; E: 80_1; F: $(TGTC)_4$; G: $(GACA)_4$; H: $(GTG)_5$ + $(GATA)_6$; I: $(GATA)_6$.

Discussion

Pleomorphism of higher fungi still causes problems for taxonomists and it is not easy to verify that an anamorph belongs to a particular teleomorph. The anamorph *Curvularia lunata* (Wakker) Boedijn was first described by Wakker (14) and classified in the genus *Curvularia* by Boedijn (15) for its asymetrically swollen and curved septate conidia. A distinct variety, *Curvularia lunata* var. *aeria* has been described by Batista et al. (16) differing by the production of large stromata in culture. In the present account, the designation *Curvularia lunata* is used to designate *Curvularia lunata* var. *lunata*. Pairing strains of *Curvularia lunata* in culture, Nelson and Haasis (7) obtained ascomata that they described as *Cochliobolus lunatus*. The link between the teleomorph and the anamorph *Curvularia lunata* was therefore established experimentally. Only distinct paired strains and none of the self-paired strains of *Curvularia lunata* could produce *Cochliobolus lunatus* ascomata in culture, showing that the species is heterothallic (7). There is no proof as yet that all strains of *Curvularia lunata* are anamorphs of *Cochliobolus lunatus*. Carmichael (17) regards the name *Curvularia lunata* as applying to an anamorph species that might consist of two or more biological species including the *Curvularia* state of *Cochliobolus lunatus*. The segregation of two varieties within the taxon might be an indication of its complexity. Any anamorph can be confirmed as pertaining to a particular sexual species either if it produces the ascocarp and ascospores of the species or if it produces the same conidia as the species. When the former test is irrefutable, the later one remains questionable, for anamorph species might be complex. Molecular methods may supply evidence of taxonomic identity by high similarity of rDNA, rRNA sequences, whole cell protein profiles, RFLP or RAPD profiles, etc. (18).

The strain named as *Cochliobolus lunatus* m118 (MUCL 38696) has been isolated in the laboratories of the Friedrich Schiller University, Jena, FRG. In 1981; the strain has been selected as a perspective microoganism for 11β-hydroxylation of progesterone (Hoerhold in sod., 1981). The strain has been under the patent law 90DD-339295 900402 in former East Germany. To our knowledge, there are no publically available records of how did the strain arrive into cultivation nor how the strain was identified as *Cochliobolus lunatus*. As the strain m118 is not producing ascospores nor conidia in our standard culture conditions, whileAT46, is producing typical conidia of *Curvularia lunata*, we searched to confirm their conspecificity by different approaches. The sporulation, obtained on V8 agar under near UV, provides a classical, but clear argument, that both strains belong to the same anamorphic species *Curvularia lunata* var. *lunata*. Therefore the ultrastructure differences observed before (9) may be due to strain (individual) variations in the culture condition applied in the laboratory.

The strains however did not cross with any of the *Curvularia lunata* var. *lunata* strains in the MUCL culture collection under conditions described by Nelson and Haasis (7). This result can be interpreted as noncompatibility. The conspecificity shown by the conidial production and morphology was supported also by enzymatic activity tests. Our strains m118 and AT46 exhibited essentially the same enzymatic activities with identical intensity, a weak difference found only on the substrate 2-naphtyl-phosphate (Table 1). Conspecificity was further supported by genomic analyses. Both strains hybridized under stringent conditions with the 1.3 kb genomic probe isolated from *Cochliobolus lunatus* m118. Since the *C. lunatus* genomic probe have not hybridized to control strains of different species, the 1.3 kb fragment could be interpreted as a *Cochliobolus lunatus* species-specific hybridization probe. The probe will have a great value in confirming the identity of antibiotic resistant, morphologically altered colonies, obtained by genetic transformation experiments with *Cochliobolus lunatus* m118 (5,10). In addition to identical RAPD markers produced by both strains, RAPD profiles show also distinguished markers between the two strains. Genotyping with longer primers based on microsatellite sequences gave more information concerning the conspecificity, especially in the case when two microsatellite primers were used in pairwise, while short arbitrary primers typed more regions where the two strains differ in their nucleotide composition. RAPD technique is sometimes too sensitive to answer general taxonomical questions since it is individual specific and common features of the group under investigation could be underrepresented if compared to individual differences.

In conclusion, the two steroid transforming strains “m118” and “AT46”, which have been widely used in biochemical and molecular biology studies but have not been taxonomically characterized so far, are distinct strains belonging to the same species. Based on our observations, they both are asexual and conidial and should be designated *Curvularia lunata* (Wakker) Boedijn var. *lunata*. Although the International Code of Nomenclature (19) recognizes the teleomorph name as the only botanical name of the species when a teleomorph has been observed, it accepts as correct the use of the anamorphic name for anamorphic strains.

Acknowledgements

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BOOK REVIEWS

D. S. Hibbett, Book Review Editor

Molecular Systematics, Second Edition, edited by David M. Hillis, Craig Moritz and Barbara K. Mable. 253 x 202 mm, 655 pp, 1996. Sinauer Associates, Inc., Publishers, Sunderland, MA. Fax: (413) 549-1118. ISBN 0-87893-282-8 - softcover (lay-flat binding). US $49.95.

To address the broad range of disciplines and rapidly evolving field of molecular systematics, the editors have obtained and compiled work of 26 contributors, and produced a well integrated and very current book. The purpose of the book is not explicitly stated, but it seems to serve best as a laboratory manual. Nevertheless, the introductory chapter and others, particularly in population biology, give thorough reviews of their fields. After the introduction, chapters are arranged in three parts on a chronological concept. Part 1, "Sampling," has chapters on "Project Design and Collection" and "Storage of Tissues"; Part 2, "Molecular Techniques," has six chapters covering "Isozyme Electrophoresis," "Molecular Cytogenetics," "DNA-DNA Hybridization," "Polymerase Chain Reaction," "Analysis of Fragments and Restriction Sites," and "Sequencing and Cloning"; Part 3, "Analysis," has chapters on "Intraspecific Differentiation," "Phylogenetic Inference," and a summation chapter on "Applications...and a Look to the Future." The chronological concept in which the parts are ordered may be helpful to some, but others may want to save Chapter 2 for last, or read the last chapter first. In fact, the last chapter provides an excellent introduction to sampling strategies for those interested in interspecies phylogenies, whereas chapter 2 focuses on population studies. The book has very useful appendices on "Measurement Symbols," "Glossary and Abbreviations," and "Literature Cited," followed by a thorough and useful index. With few exceptions, I was able to track down the meanings of esoteric terms using the appendices.

Arrangements of most chapters follow a standard format which works very well. The principles involved in the analysis are discussed at length, then the laboratory techniques with extensive protocols and diagrams, then sections on interpretation and trouble shooting, and finally appendices including standard solutions. Again, depending on the reader's familiarity with the subject areas, these sections need not be read in order. In many chapters, the most detailed and best illustrated aspects are the laboratory protocols and diagrams of apparati.

Molecular Phylogenetics can serve as a source book for the most relevant (and very current) literature, as well as an outline of current controversies and concepts. In some chapters, however, the presentation of introductory material is scant and the underlying principles are not explained or illustrated for the lay biologist. This would be a difficult task in the space allotted, considering the sophisticated mathematical principles often involved. Nevertheless, the chapter "Phylogenetic Analysis" is a case study in how best to present such concepts to a wide audience. This chapter combines extensive mathematical treatment with intuitive illustrations, and discussion readily accessible to those with no more than passing familiarity with the mathematics. This chapter alone makes it worth keeping the book handy on the shelf above your desk or available to your research group. "Phylogenetic Analysis" is a "must read" along with "Storage of Tissues," and "Applications..." Sections of the other chapters will be very helpful to many depending on their fields and applications of choice. Another extremely well presented chapter is "Molecular Cytogenetics." Unfortunately for the mycologist, electrophoretic karyotyping is not included. Even so, the treatment of cytogenetic principles is so clear and well illustrated that mycologists interested in karyotype analysis would do well to read it.

I would suggest purchasing this book and keeping it at your fingertips, alongside (depending on your specific interests and applications) primers on population genetics and molecular evolution, as well as a laboratory manual on gene cloning and analysis. The combination should serve many researchers very well. *Christopher L. Schardl, Department of Plant Pathology, University of Kentucky, Lexington, KY 40546-0091 U.S.A.*

The genus *Hygrocybe*, by David Boertmann. 230 x 165 mm, 184 pp, 1995. Fungi of Northern Europe vol. 1. The Danish Mycological Society, P.O. Box 168, DK-2670 Greve, Denmark. Fax: 45-4369-9802. ISBN 87-983581-1-1-1. Dkr 198.

David Boertmann's publication is a mine of information presented in an attractive way; it is a distillate of over twenty years of laboratory and field studies. The book is primarily an identification guide with special attention paid to Denmark, but including Europe from northern Norway, Ireland, and Greenland to the Alps.

The text clearly sets out the author's aims, the systematic arrangement employed, and the characters utilized, supported by sadly rather simplified line-drawings. The definition of the genus is quite short but it is accompanied by an artificial key based on macroscopic features and a systematic key calling upon spore sizes, tramal length, etc. The synoptic key is really a listing of species within a framework of set field and microscopic characters. *Hygrocybe* covers subgenera *Pseudohygrocybe*, *Hygrocybe*, and *Cuphophyllus*, or the old subgenera of *Hygrophorus*, *Hygrocybe*, and *Camarophyllus*.

The main body of the book considers each accepted species in turn, with a full description, ecological data, a discussion on special features and related taxa, a color illustration, and line-drawing of the spores. The distributional data include a dot map for Europe, while the text gives a world flavor.

The basionym with literature citations but synonyms without, and misapplied names are given before a succinct two-line species summary. The synonyms and discussion are supported at the back by a list of species insufficiently known and of material studied. The bibliography is full.

There has been a great amount of activity in the last few years in connection with the analysis of temperate hygrophori; Boertmann's book is an excellent summary. There is no doubt that it will be of great use to a whole range of workers including ecologists who want to use these fungi as indicators of habitat quality and potential pollution problems. The book will be of use outside of the designated area.

Some familiar names have been lost, e.g. *Hygrocybe reai*, some reduced to varieties, e.g. *H. conicoides*, and others reinterpreted, e.g. *H. cinerea*. The reasons are clearly and concisely given and the reviewer has been suitably impressed.

If this is the first of a projected series then anything else which follows will have to be of an equal or higher standard, which is difficult to see. The quality of the color photographs is excellent and the text is clear; the printing is clean and fresh, and thankfully it is in English. [This volume is also available in Danish. *D.S.H.*] A must for any mycological library; it would be good to see a parallel volume for the United States building on Hesler and Smith's 1963 work (**North American Species of Hygrophorus**, University of Tennessee Press, Knoxville). *Roy Watling, Royal Botanic Garden, Edinburgh, EH3 5LR, Scotland.*

Overzicht van de Paddestoelen in Nederland, edited by E. Arnolds, Th. W. Kuyper, and M. E. Noordeloos. 265 x 195 mm, 872 pp, numerous b&w illustrations, 80 distribution maps, 16 colored plates, 1995. Netherlands Mycological Society, H. Lammers, Hoofdstraat 92, 5706 AM Helmond, The Netherlands. ISBN 90-802818-1-6 – clothbound. Dfl 35, plus postage.

Despite the text being in Dutch, this most fascinating overview of the macrofungi of The Netherlands is an essential resource for professional and amateur mycologists, providing very probably the most complete checklist of the higher fungi published for any comparable area. An extensive English summary (pp. 860-866) is a welcome tool for access to the wealth of data provided here for the 575 genera and 3488 species treated in the taxonomic part. It is unfortunately easily overlooked by someone merely flipping the pages, since it is not clear from the table of contents that the entry "Summary" refers to an English summary.

This work is an outgrowth of the earlier **Standaardlijst van Nederlandse Macrofungi** by Arnolds, published in 1984. Each entry includes the accepted scientific name, vernacular name, selected literature references, distribution and ecology, status according to the preliminary Red Data List of endangered species, and notes on variation and taxonomic position. This book provides an important source of data for future studies on changes in the mycota. Each genus was assigned to one or more of the 24 amateur and professional mycologists who contributed to the volume.

The limits of what constitute macrofungi are necessarily arbitrary, and inclusion of many minute discomycetes and pyrenomycetes may surprise some readers. The taxonomic part devotes 392 pages to Agaricales, 112 pages to Aphyllophorales, 16 pages to Phragmobasidiomycetidae, 26 pages to Gasteromycetes, and 141 pages to Ascomycotina, with a wealth of information about each taxon.

Many delightfully rendered line drawings are scattered throughout the text. Additional delights to the eye are the mandalic illustrations composed of fungal fruit bodies on the cover and title page and the handsome colored plates from watercolors by Eef Arnolds. I do question why these plates are spaced within the text, which works well when the figures are adjacent to the text that is involved. Here, to my mind unfortunately, illustrations of *Psilocybe*, *Russula*, and some Aphyllophorales are found amid descriptions of discomycetes. The plates might better have been brought together at the end of the text, where they could have been enjoyed as a unit.

Richard P. Korf, Plant Pathology Herbarium, Cornell University, Ithaca, NY 14853, U.S.A.

Dipterocarpaceae: Mycorrhizae and Regeneration, by W.T.M. Smits. 243 pp, 74 figures, 28 tables, 9 boxes, and 9 appendices, 1994. Tropenbos Series 9. Backhuys Publishers, P.O. Box 321, 2300 AH Leiden, The Netherlands. Fax 31-71-171856. ISBN 90-5113-121-X - softcover. NLG 96.00.

This book is a compilation of the author's original research on Dipterocarp mycorrhizae. The first and last chapters serve to introduce the topic, to summarize the major findings, and to discuss future directions, while the other six chapters are in the form of separate sampling or experimental studies. The introduction is interesting reading for outsiders to the field, and does a good job of summarizing basic aspects of the biology, biogeography, and history of commercial forestry for this important family of tropical ectomycorrhizal trees; it also contains a short but useful introduction to mycorrhizae. The final chapter is not as concise, but does serve to reinforce the three central themes of this book: 1) Dipterocarps are obligately ectomycorrhizal; 2) they are highly specific in their associations; and, 3) these two features explain much of their patchy pattern of establishment, the problems associated with their re-colonization, and perhaps speciation of the Dipterocarps. The last two themes are timely, given the recent interest in mycorrhizal specificity and mycorrhiza-mediated plant dynamics.

The research chapters, two through seven, are quite diverse and could easily be separated into six or more individual journal articles. In some ways it is unfortunate that they were not, because they deserve a greater readership than a specialized book is likely to give them and they could have benefited from the rigor of peer review. The second chapter in particular is a little disjunct in its presentation, with keys, descriptions, sampling schemes, experimental manipulations, observations, and random speculations all crammed into a single long chapter. This is unfortunate because the results presented in this chapter are important to the issue of specificity, but the arrangement and analysis of the results makes it difficult to assess the strength of those data. For example, table 8, which is referred to often for evidence of specificity, does not contain sample numbers for either the hosts or the fungi. The former can be found in the next table, but the latter are nowhere to be found. No statistics are given anywhere to show that the distribution of fungi among the hosts is significantly different from random. Stronger data in support of specificity are presented in chapter five where results of planting multiple species in perforon chambers are discussed. Perforons are essentially large root chambers which allow observation and sampling of roots through multiple pores. The author used them to show that several mycorrhizal types stayed true to their specific hosts when planted in the same chamber, even though contact occurred between every possible pair of host roots and fungi. Other research reported includes field sampling of mycorrhizae, additional inoculation experiments, manipulative experiments of soil temperature and soil compaction, and a description of a new and unique type of ectomycorrhizae formed by *Riessia* spp. and *Riessiella* spp.

The large number of figures, tables, and explanatory "boxes" is one of the strong points of the book. They often help to make the results more readily accessible, but unfortunately, some of the legends are not sufficient to explain the figures, and the non-sequential order of photographic figures is a little annoying. The boxes provide a set of interesting side issues. Collectively they make it very easy to open the book to any spot and get lured into reading further. Box 7, which introduces the perforon technology really helped to clarify the design of some the most interesting experiments. One of my favorites, box 9, contained a discussion of the etymology of the word mycorrhizae and the justification for its current spelling and plural form—British mycologists need to read this. Another strong point of the book is that it is well referenced. Relevant works, both current and historical, are cited. As I read the book I marked many of these to find and read later, and I know the book will remain a valuable reference for this reason.

This book is clearly a useful purchase for anyone working in Dipterocarp forests, and the descriptions and keys to mushrooms will likely be an aid to mycologists working in Borneo for other reasons. I would also recommend the book to anyone interested in mycorrhizal ecology because it contains a wealth of interesting observations and ideas. *Thomas D. Bruns, Department of Plant and Microbial Biology, University of California, Berkeley, CA, 94720.*

The following texts on biology of mycorrhizae were also recently received by **Mycotaxon**. *D.S.H.*

Biotechnology of Ectomycorrhizae, edited by Vilberto Stocchi, Paola Bonfante, and Marco Nuti. 255 x 170 mm, 251 pp, 1995. Plenum Press, 233 Spring Street, New York, NY 10013. ISBN 0-306-45126-3. US $85.00.

La Symbiose Mycorhizienne: État des Connaissances, edited by J. A. Fortin, C. Charest, and Y. Piché. 240 x 160 mm, 195 pp, 1995 (French, with English summaries). Éditions Orbis Publishing, 8 Chemin Abbott's Corner, Frelighsburg, Quebec, J0J 1C0, Canada. Tel: (514) 298-5079. ISBN 2-9800545-7-7.

***Tomentella* and related genera in temperate Eurasia,** by Urmas Kõljalg. Softcover, 225 x 155 mm, 213 pp., 171 figures and 2 tables, 1996. Fungiflora A/S, Box 95, Blindern, N-0314 Oslo 3, Norway. ISBN 82-90724-16-0. NOK 250–, plus postage

The four genera treated in this monograph are *Amaurodon* (6 species), *Pseudotomentella* (8), *Tomentella* (43) and *Tomentellopsis* (3). There are keys to the genera and to the species. Detailed descriptions, line drawings, SEM pictures of basidiospores, and distribution maps are given for the species in temperate Eurasia, i.e., the former Soviet Union. For the extralimital species, e.g., *Amaurodon aeruginascens* from South America, *A. atrocyaneus* from Europe and South America, *A. cyaneus* from Europe, *Tomentella aurantiaca* from Guadeloupe, *T. bicolor* from North America, *T. duemmeri* from Uganda, *T. kentuckiensis* from the USA, *T. rufobrunnea* from Ceylon, and *T. subalpina* from Canada, only the basionym, citation of the type specimen studied and remarks are included.

Several new taxa are proposed: five new combinations in *Amaurodon* and one in *Tomentella*, one new subgenus in *Tomentella*, and three new sections in *Tomentella*. Several generic names are relegated to synonymy, some apparently for the first time, e.g., *Hypochnopsis* and *Lazulinospora*.

A large number of type specimens were studied and extensive new synonymy is proposed based principally upon these studies. For example, eleven of the species names proposed by M. J. Larsen have been placed in synonymy. In at least one case, *T. neobourdotii*, the name was placed in synonymy based solely on the study of a specimen (not cited) in PR. Except for citing the type specimens there is no discussion of the synonymy.

As in earlier studies of the tomentelloid fungi, considerable emphasis is placed on the size, shape, ornamentation and color of the basidiospores. The excellent SEM pictures which detail the ornamentation and shape of the spores will be a distinct asset for users trying to identify unnamed collections. But the terminology used for spore shapes and ornamentation differs from earlier studies and this may make comparisons of descriptions between studies inconvenient

The brevity of some comments may leave the reader with unanswered questions. For example, the type of *T. kentuckiensis* is stated to be "close to *T. sublilacina*." If this is true, why is *T. kentuckiensis* in sect. *Testaceogilvae* with *T. testaceogilva*, and *T. sublilacina* in sect. *Brunneolae* with three other species?

The specimen cited as "Lectotype" for *A. viridis* should be classed as "Neotype" because the North American specimen was collected a decade or more after the name was published in a European flora. The spores of *A. mustialaensis* are described as smooth and the SEM shows smooth spores still attached to sterigmata, but are they mature spores (cf. fig. 35c showing immature and mature spores)? I wonder if spores from a spore cast would be ornamented? It would have been helpful if one distribution map had the political subdivisions labeled with the major regions cited in the text.

The characters of each taxon were recorded in the DELTA format. Phylogenetic analyses were conducted using the programs PAUP and PEE-WEE. The character list for DELTA included 105 items and it is a good example for others contemplating using this program.

This is a well prepared monograph and careful attention has been paid to detail. It should be useful to mycologists in a variety of countries because most of the species have a wide distribution, at least in the Northern Hemisphere. *J. Ginns, National Mycological Herbarium, Agriculture & Agrifood Canada, Ottawa, K1A 0C6 Ontario.*

MYCOTAXON

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NOTICE

EMILE BOUDIER'S FAMOUS *ICONES MYCOLOGICAE* AGAIN AVAILABLE

Mycologists will delighted to learn that the supply of the 1981–1982 four-volume reprint of Boudier's *Icones Mycologicae,* long believed to have been lost, was recently discovered and rescued by a Swiss amateur mycologist, just prior to its planned destruction. He is now selling these. This reprint edition was published by Editions Piantanida Lausanne, in Switzerland. It differs from the original edition (1904-1911) in providing a new, FIFTH volume, published in 1985, containing the series of preliminary lists and explanations of the plates that were frequently discarded by recipients, as well as a brief introductory note by Dr. J. van Brummelin and extensive taxonomic and nomenclatural revisions of the species that Boudier illustrated, prepared by Drs. Richard P. Korf (Discomycetes, Pyrenomycetes, *Pilobolus*, Deuteromycetes, *Fuligo*), Heinz Clémençon (Agaricales), Walter Jülich (Aphyllophorales, Phragmobasidiomycetes), and Vincent Demoulin (Gasteromycetes).

Korf had long searched for these 'lost' reprint volumes, which contain 600 exquisite colored plates in folio size. In his words, from volume 5: "Not only do I know of no more beautiful set of illustrations of fungi than these superb works or art and works of scientific accuracy, it was the discovery of these astounding plates that led me initially to a serious study of the discomycetes, and to find in them a lifelong passion." The reprint edition clearly captures very nearly all of the nuances of the earlier lithographs.

The complete 5-volume reprint is available at 800 Swiss francs, plus postage and handling. (When issued, the 1985 price was 1750 Swiss francs.) Postage for the set will cost between 43 and 127 francs, depending on postal zones, while handling charges now run 8 francs. Since many libraries that possess the original 1904–1911 edition lack the material of the important fifth volume, that volume may be ordered alone, at 75 Swiss francs. Single volumes 1 through 4 are 180 Swiss francs. Postage for single volumes runs between 22 and 39 francs at current rates. If your institutional library is lucky enough to have the original printing, be sure they also order volume 5 of the reprint. If they don't have the original, do all you can to get them to order the whole set!

To order, please contact Mr. R. Morier-Genoud, Av. Senalèche 23a, CH-1009 Pully, Switzerland. He can be reached by fax at 41-21-320-0906. He accepts checks or bank transfers, but not credit cards.

R. P. K.

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page	11	line	37	*for*	Herpobasdium	read	*Herpobasidium*
	18		13	*for*	autmatic	*read*	automatic
	118		3	*for*	hidden be the	*read*	hidden by the
	125	l. 17	[two errors]	*for*	Endopsorisorum	read	*Endosporisorium*
	141	col. 2, line 5		*for*	Condia	*read*	Conidia
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